Chapter 5
Deforestation in the Tropics

5.1 Deforestation Tragedy of Socialistic Forestry

> That corruption benefits at least some of those in power makes it a difficult problem to tackle. (p. 3 in Klitgaard 1988)

5.1.1 Introduction

The aim of this section is to analyze the specific problems of socialistic forestry in relation to corruption, underpricing, illegal logging, and deforestation in the tropics. The theoretical hypothesis will be sharpened and empirically tested with deforestation data and a review of literature.

Ecologist Garrett Hardin's (1968) eminent paper was titled "The Tragedy of the Commons." In the terminology of economics he described the behavior of "Homo economicus" in maximizing his utility in the context of "open access" resources and consequent environmental deterioration (Bromley 1991). Our focus is here the same tragedy but restricted to the deforestation tragedy of socialistic forestry, which brings novel insights to the pertinent tropical deforestation problem.

The special theoretical features of different forest ownership categories were introduced in Sect. 2.5. The historical evolution of peasantry along with the Great Land Reform since 1757 brought the majority of forest ownership to the farmers in Finland about a century and a half ago (Sect. 3.5).

Under the consequent specific forest-based development in Finland until 1960, strong and clear private forest ownership appeared to support forest transition in

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terms of equal income distribution and alleviation of poverty. The social opportunity costs of sustainable forestry were reduced under simultaneously expanding demand for timber and increasing value of the remaining forest. Deforestation in Finland was gradually ended and forest transition took place during the first part of the twentieth century (Sect. 4.6).

We may ask why the governments have worldwide been interested in acquiring forest ownership? In the case of Finland the Swedish kings of the sixteenth and seventeenth centuries were motivated for government ownership of forests due to their strategic importance for the navies, commercial fleets, mining, and ore processing. The kings also paid attention to public forests as reserves for colonization of increasing population in order to get more taxpayers and to recruit more soldiers (Chap. 3).

Great Britain, France, Germany, Japan, the United States, and some other colonial powers in the eighteenth and nineteenth centuries were motivated to socialize their colonial forests for strategic reasons (Palo 2001a). The contemporary tropical country governments may be motivated to maintain wide public ownership of forests (Photo 5.1) due to the opportunities for corruption and colonization.

The behavior of private non-industrial forest owners has been frequently studied in Finland (e.g., Karppinen 2000; Kuuluvainen et al. 2006), in Sweden (e.g., Lönnstedt 1997), in Germany (e.g., Lammel 1977), and in the United States (e.g., Newman and Wear 1993). The last one included a comparison between industrial and non-industrial forest owners. This kind of comparison was also executed early in Finland (Renvall 1915). Beach et al. (2005) reviewed globally 41 econometric studies of non-industrial private forest management.

Community forestry has received over the past three decades increasing attention and research (e.g., FAO 1993a; Ostrom 1999).

While about 90% of the tropical forests are in public ownership, it is quite natural to start this chapter by analyzing the behavior of socialistic forestry. State forestry in a minority has been somewhat studied both in the United States and in Finland (e.g., Sedjo 2000; Rytteri 2006; Parpola and Åberg 2009), but research on state forests in a majority or socialistic forestry from the theoretical point of view, e.g., of property rights and public choice theory, has been minimal.

Barbier et al. (2004) provided one exception in this front. They developed an open-economy model in which deforestation was determined by a self-interested government that is susceptible to the impacts of the political contributions it receives from the profit-maximizing economic agent responsible for forest conversion. The direct effect in the tropical countries was as expected: increased corruption led to greater deforestation. Corruption also had an indirect effect on deforestation via interaction with the terms of trade.

We made above a review of recent studies on deforestation and forest transition (Sect. 2.2). A fresh study concluded that “there is no clear agreement on what are the ‘true’ causes of deforestation” (p. 151 in Amacher et al. 2009). The authors also made a note that forest economists have been engaged too little regarding the role of corruption in the forest sector. We try in this section to fill this gap in a more general way and in the following sections with more detailed modeling.

Photo 5.1 Tropical rainforest in Mindanao island in the Philippines in 1990 (Photo: Martti Saarilahti)

The high social opportunity cost of sustainable management of natural tropical forests is, at least partly, artificially made by underpricing the stumpage and other forest goods and services. We may ask why? After about half a century of forestry development projects by the FAO, and for a somewhat shorter time by the World Bank, ITTO, and other international and national development agencies (Sect. 5.7), how and why is this kind of undervaluation of tropical natural forests and consequent deforestation continuing?

In this section we respond to this question. We shall next describe the concept of socialistic forestry.

5.1.2 *What Is Socialistic Forestry?*

The contemporary tropical countries with mostly public ownership of forests have faced a contrasting situation to Finland (Chap. 4). The problems of public forest ownership are further actualized under a situation where the government is the sole owner of all the forests or of the majority of forests in a country. It is as a rule accompanied by a centralized administrative setting of stumpage prices. Financial

profitability or quality of logging never became an objective for state foresters under these circumstances. Such a regime we refer to as socialistic forestry. It is in many aspects different from mere state forestry, where the state-owned forests exhibit a minority in a country.

Efficient prices play a key coordinating role in a market economy without any central planning authority. Efficient prices reflect our preferences and lead to efficient allocation of production factors. No single buyer or seller can manipulate an efficient price. Efficient or scarcity prices clear the market. Efficient prices correctly inform buyers and sellers of the cost (the forgone alternatives) at which goods and services can in fact be provided if people are free to make such offers they wish. Approximations to efficiency prices can be found through the interaction of demand and supply in competitive markets (e.g., Lindblom 1977).

In centralized administrative setting of stumpage prices under socialistic forestry the price setting is arbitrary. The coordinating function of efficiency prices is lost. Such stumpage prices do not signal scarcity of resources. Systematic underpricing of forest leads to deforestation and waste of timber in logging, haulage, and processing as well as to lack of motivation to intensify forest management and to increase value added in processing of wood.

Socialism has been defined as “a system or condition of society where the means of production are owned and controlled by the state” (Webster 1989). If private forestry has a majority ownership in a country, the minority is here called state forestry. Then the Forest Service commonly applies stumpage and delivery price references from auctions, as in the United States (Sedjo 2006) or from the private market-based forestry under non-corruptive conditions, as in Finland (Sect. 4.4).

The market-based state forestry in Finland has been executed since the establishment of the Forest Service in 1851 with a financial profitability requirement of its director and board. It has motivated for 150 years the staff of the Forest Service to increase productivity and other means toward better profitability and sustainability. Since 1880, with only exceptions of three years, the annual revenues have exceeded the annual expenses. State forestry has also been managed sustainably (Rytteri 2006).

The socialistic forestry in the tropics has been lacking such a motivation (Westoby 1978; Bromley 1999). It is in line with the previous regime of the Soviet Union. Profitability and efficiency did not play any role in such a regime (Tansey 2000; Lindblom 1977).

Since about 1970 state forestry under the Finnish Forest Service has strongly developed forest protection and multiple uses of the public forests, partly based on the markets. Sustainable forest management has been the goal since 1994. Socialistic forestry along with FAO (p. 211 in FAO 2010a) has classified forests into “production forests,” and “protection, conservation of biodiversity, social services and multiple use forests.”

Commercial timber production has traditionally been “production,” while the conservation of biodiversity and erosion protection has been “non-production” activity. Especially the ecosystem services have been regarded as non-production. This attitude resembles the socialistic practice in the previous Soviet Union, where services in general were not relevant in the material accounting of the national economy (Palo 1993).

The "non-production" attitude of socialistic forestry has forgotten that an economic system aims with efficient use of scarce resources to satisfy human wants. How could production of paper be more productive than writing on that paper? Blank papers hardly satisfy human wants. Most services complement the consumption of physical goods. Services can also improve production processes or life of the workers, which again can increase productivity (Korpinen 1989).

Socialistic forestry has been characterized by central planning. Foresters in general have largely favored national "master planning" of forestry with little reliance on developing the various markets competitive within forestry. The "Gosplan" system of central planning was never developed operationally enough under the past socialistic regime of the Soviet Union (Tansey 2000).

On the contrary, the Gosplan had strong negative effects on the development of natural resources and the environment in the Soviet Union. The links between the Gosplan and the depletion of natural resources and the environment became evident (Nilsson et al. 1992). The Soviet regime finally collapsed in 1991.

State forestry and private forestry rely on markets, while socialistic forestry relies on administrative pricing by hierarchy below the market prices. This is necessary to allow a financing source for corruption. As a rule socialistic forestry has been accompanied by corruption and illegal logging. This pricing practice is equal to the Gosplan model. Both private forestry and state forestry in Finland have demonstrated the key roles that markets, stumpage markets in particular, have played in the forest transition of Finland (Sect. 4.6).

The Gosplan in the Soviet regime determined prices and production quotas centrally instead of relying on the market. Achieving or exceeding the target quotas became the main objective for the managers, not financial profitability. Quality, services, and customer preferences and satisfaction played only minor roles in this regime. This was perhaps one of the most serious problems in the operation of the Soviet socialist economic system. In a similar way, we regard this underpricing of stumpage as a major hindrance to sustainable forestry.

Corruption has been a common denominator for socialistic forestry and of a number of communist and socialist regimes in the developing countries. Corruption has been found to be a serious problem in Angola, China, Cuba, Tanzania, and Vietnam by Klitgaard (1988). "Western critics find corruption a natural result of communism's allocation by the state and lack of political and economic competition" (p. 206 in Klitgaard 1988).

According to the theory of property rights (Sect. 2.5) socialistic forestry already is problematic in various ways. The *efficient property rights structure* is universal, exclusive, transferable, and enforceable. It also requires separability of rights and a full specification of rights and duties for the property owners and non-owners. Universality means that all resources are privately owned. Exclusivity refers to a situation where all benefits and costs accrue only to the owner. In the case of strong externalities or public goods, public or community ownership is theoretically preferable to private ownership.

Transferability means that property rights are transferable from one owner to another on a voluntary basis. This feature is a guarantee for a generation shift and is

highly important for long-term investments in forestry. Forest holding markets are missing under socialistic forestry. They play an important role under private forestry by shortening the planning horizon of long-term forestry investments. The owner can benefit from the future return of such investments in increasing collateral for credit or in higher value of the holding in case of selling the holding.

Also many problems have appeared in practicing socialistic forestry, such as heavy bureaucratic decision-making, lack of local knowledge, wide-scale corruption with illegal logging, and related ineffective enforcement.

In the tropical countries especially, the socialistic forestry regimes have mostly been lacking the political will and capacity to close the access to public forests, and such forests have in practice become *de facto* open access resources with illegal logging leading to forest degradation and deforestation (Bromley 1991, 1999; White and Martin 2002; Deacon and Mueller 2006; Bulte and Engel 2006; Douglas and Simula 2010).

Next we shall turn to the scale of public forest ownership.

5.1.3 Share of Public Forest Ownership

White and Martin (2002) assessed that 77% of the world's forests are in public tenure, while FAO (2006) estimated 84% mostly owned by the federal and individual states. The most recent estimate by FAO was 80% (Fig. 5.1). Sunderlin et al. (2008) assessed that 80% in 2002 and 76% in 2008 of the global forest area was administered by governments. The last estimates were based on the 30 most forested countries.

Europe has a high government proportion due to the inclusion of Russia. In the tropical continents the public ownership is dominant in 64 countries, such as Brazil, Indonesia, and DR Congo with only 16 small countries as exceptions, such as Costa Rica, Mexico, and Papua New Guinea (FAO 2010a).

In the tropical countries public ownership of forests is about 90% (Fig. 5.1). This higher percentage than the world average is partly due to the past colonial powers. They ignored the customary property rights and declared in their new statutory property rights that all the forests belong to the crown and the state. Later on, after independence, the new governments continued on the same path (Bromley 1991).

Katila (2008) reviewed the existing explanations of the failure of public forest ownership as follows. "The main reasons behind the failure of the centralized forest management have been the vast size of the forest areas, limited financial resources, and administrative, technological, and enforcement capacities of the states, corruption, insufficient information concerning forest ecosystems, and the failure to recognize customary rights to land."

In a closer analysis of these explanations, we may find corruption as the major underlying cause behind this failure. Corrupt politicians and civil servants maintain low stumpage prices and consequently limited forestry incomes with limited finances to forestry, with inadequate recruits of staff and too few vehicles, spare

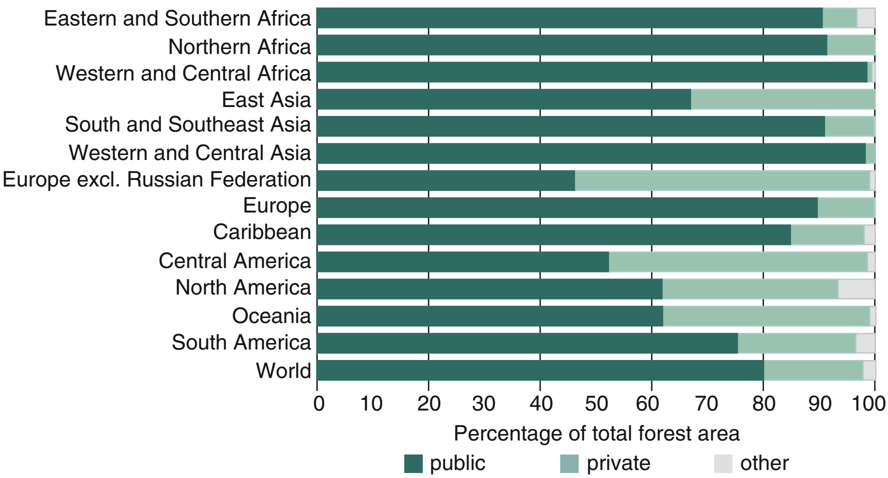


Fig. 5.1 Public, private and other forest ownership by subregion (FAO 2010a)

parts and gasoline to cope with the large forest areas. Under corruption it is also better not to allocate money to forest research and forest inventories, because they might reveal the plundering taking place in the public forests.

Next we shall describe the chain of corruption → underpricing in socialistic forestry.

5.1.4 Socialistic Forestry, Corruption, and Underpricing of Stumpage

Transparency International (TI) defines corruption as the abuse of entrusted power for private gain. This definition encompasses corrupt practices in both the public and private sectors. The Corruption Perceptions Index (CPI) ranks countries according to perception of corruption in the public sector. The CPI is an aggregate indicator that combines different sources (Transparency International 2010).

Our corruption analysis is restricted here to the public sector as a misuse of a public office for private gain. Private forest ownership can maintain only a few such public offices but no similar public financing source for corruption. Therefore, private forestry without large public subsidies cannot support corruption on a wider scale.

When private plantation forests are created with public subsidies, corruption opportunities have appeared in some otherwise already corrupted countries. Wide corruption is unknown in private forestry industrialized countries and also in tropical Costa Rica with a majority of private forestry. On the other hand, socialistic forestry facilitates a high number such opportunities for corruption.

Table 5.1 Social costs of corruption (Klitgaard 1988)

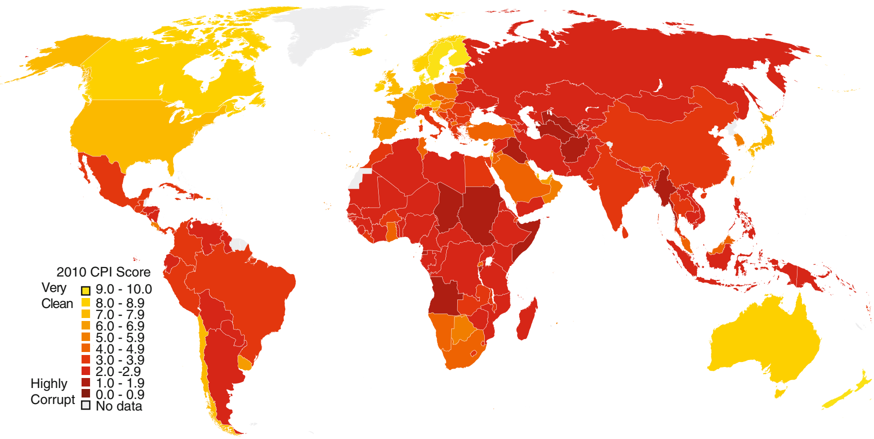
Efficiency	Wastes resources
	Creates "public bads"
	Distorts policy
Distribution	Reallocates resources to rich and powerful, those with military or police power, or those with monopoly power
Incentives	Distorts energies of officials and citizens toward the socially unproductive seeking of corrupt rents
	Creates risks, induces unproductive preventive measures, distorts investments away from areas with high corruption
Politics	Breeds popular alienation and cynicism
	Creates regime instability

Corruption, on the other hand, is supporting public ownership of forests, because administratively set low stumpage prices in public forests provide a financing source for corruption. Corrupted conditions promote illegal logging and other illegal forestry activities. Corruptive conditions tend to favor the rich and deteriorate the lot of the poor (Table 5.1). "Raubwirtschaft" or "plunder economy" could be a descriptive illustration for this activity.

The Corruption Perceptions Index of Transparency International assesses primarily tropical countries among the most corrupted countries (Transparency International 2010). There were 178 assessed countries in the whole world in 2010. The tropical countries had the following ranks counted from the least corrupted countries of Denmark and New Zealand: 56 tropical countries among the worst ranks of 100–180. The map demonstrates the high cover of serious corruption among all the tropical countries in the three tropical continents (Map 5.1).

"As the evidence mounts about corruption in developing countries, it seems clear that the harmful effects of corruption greatly outweigh the (occasional) social benefits" (p. 36 in Klitgaard 1988). The social costs of corruption can be grouped according to four main criteria (Table 5.1). At the top we observe that corruption wastes resources. This can be enlarged to cover both natural resources, such as forests, and human resources. Removing corruption has its costs. Therefore, the optimal amount of corruption is not zero but in the intersection of the marginal cost curve of removing corruption and the marginal cost curve of corruption.

Under socialistic forestry timber sales take place mostly by selling standing timber with concessions or with other related terms. The buyers, as a rule, are responsible for logging. Under the circumstances, they maximize the profit per cubic meter of logged timber, while if the sellers would be responsible for logging, they would in theory maximize the profit per hectare as a joint venture of logging and forest management (Sundberg and Silversides 1988). Even, if the contract *de jure* demands reforestation or other silvicultural activities by the buyer, corruption *de facto* eliminates such requests.



Map 5.1 Corruption perceptions index 2010 (Transparency International 2010) (1 = high and 10 = low corruption)

State forestry in Finland started a transition from concession sales of timber to delivery sales for about a century ago. The motivation under already non-corruptive conditions (Sect. 4.5) then was to improve the financial result of the timber sales. The Forest Service did then actively also raise the demand for logs by establishing sawmills and a pulp mill (Sects. 4.4 and 4.5).

The above references to Finland have to be understood as cases in support of the hypothesis of Fig. 2.4, and specifically in support of “value of forest” (above the “local agents”) and not as direct comparisons between Finland and some tropical countries. The Finnish cases illustrate state forestry practices as different from socialistic forestry.

Finally, the procurement agreements were made up to ex-mill locations of the forest industries. This has produced the best financial result under state forestry in Finland. Here is the fundamental difference between state forestry and socialistic forestry. The former provides a motivation to strive toward public good, but the latter under corruption does not motivate the staff for public good but instead for individual rent seeking and corruption.

Corruption of civil servants in the context of commercial logging in the tropical countries has been identified as a widespread problem (Map 5.1; Bromley 1991; Kasa 1999; FAO 2001a; Douglas and Simula 2010). For financing corruption, administrative pricing of standing timber has been practiced below the respective shadow stumpage prices computed from the competitive markets of processed products (e.g., FAO 2003; Repetto and Gillis 1988; Treue 1994; Angelsen and Wunder 2003).

Next we shall introduce the hypothesis that underpricing of stumpage is increasing deforestation in the conditions of socialistic forestry.

5.1.5 Hypothesis: Underpricing of Stumpage Creates Excess Deforestation

Our universal system causality hypothesis was introduced in Fig. 2.4. “Value of forest” is located there just above the “local agents.” This proximate location reflects the assumption that a high value for forest supports forest transition and a low value slows it down. “Value of forests” is closely linked with “property rights” and “corruption.” Reasonable valuation of forests can be achieved only under closed access conditions and under sufficiently low corruption.

Corruption motivates civil servants to underprice the public forests, which again facilitates financing of corruption. Underpricing of stumpage of timber or the whole forest with socially excess deforestation as its consequence is illustrated in Fig. 5.2.

Line MR represents the market demand for deforestation or permanent clearing of forests for various purposes by the local deforesting agents (Fig. 2.4). It can be interpreted as derived demand from demands for forest and agricultural products and for other products, which require forest clearing. Line MR can be viewed as a marginal revenue curve for the local deforesting agents. From this perspective we are viewing marginal cost and revenue curves and their intersections by the local deforesting agents.

The marginal cost lines MC_0–MC_3 cover only the costs of stumpage to the local deforesting agents with different pricing principles as the function of the quantity of deforestation. Our specific interest here is to illustrate how the different stumpage pricing principles and levels of these prices affect the extent of deforestation.

Line MC_0 refers to the marginal costs for the local agents with a lump sum fee for the whole concession, MC_1 refers to marginal costs with a lump sum plus a low (lower than the market price) administrative stumpage price per m^3 and no internalized external costs, line MC_2 to marginal costs with competitive market pricing but excluding external costs, and line MC_3 to marginal social costs with competitive market pricing and internalized external costs. The MC lines represent supply curves for deforestation by the local deforesting agents.

A local deforestation agent (e.g., a farmer or a logging contractor) with, e.g., MC_1 finds his optimum quantity of deforestation (most efficient amount of deforestation) with a stumpage price P_1 in Q_1, with MC_2 and stumpage price P_2 in Q_2, while the social optimum (provided the social opportunity cost of forestry $<P_3$) without socially excess deforestation would with price P_3 be in Q_3. Excess deforestation Q_1–Q_2 is a result of administrative undervaluation of standing timber and forest. It increases with P_2–P_1, which can be called the social opportunity cost for sustainable forest management. Subsidies for agriculture or tree planting have similar impacts on deforestation of natural forest. In both cases the social opportunity cost of sustainable management of natural forests is artificially increased.

Excess deforestation Q_2–Q_3 (Fig. 5.2) is caused by the missing markets for socially positive forest externalities of biodiversity, carbon sequestration and stocks, soil and water conservation, maintenance of landscape, ecotourism services, etc.

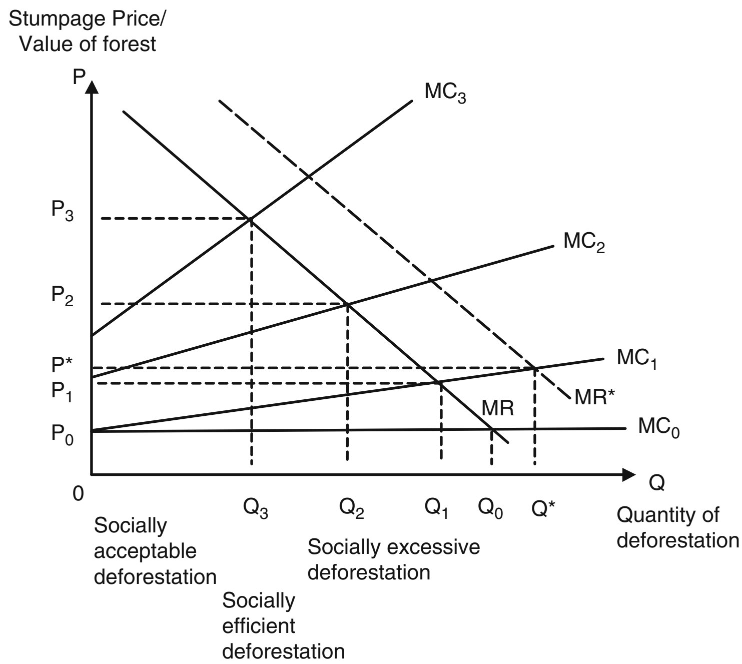


Fig. 5.2 Impacts of shifts in marginal costs and revenues on excessive deforestation by local deforesting agents

The opportunity cost due to the externalities is reflected by P_3–P_2. This refers to government and market failures of not being able to internalize these externalities, which further increases the social opportunity cost of sustainable forestry.

We may conclude as a hypothesis to be tested below that undervaluation of forests, and especially of stumpage prices, leads to socially excess deforestation. Under expanding domestic consumption or exports the derived demand for deforestation will shift the line MR to the line MR*. This shift in demand would expand deforestation by Q^*–Q_1 and increase the opportunity cost of sustainable forestry by P^*–$P_{1.}$

An average revenue per cubic meter of roundwood production was computed as USD 0.19 and for industrial roundwood as USD 2.42 in 22 African countries in 1999. "Low forest revenue not only has a negative impact on total government revenue and expenditure, but also sends incorrect price signals to the market about the value of forest and wood. Such messages are damaging to sustainable forest management in that low prices can result in overharvesting and undervaluing of the resource, both of which contribute to deforestation and forest degradation" (p. 112 in FAO 2003).

Low stumpage prices lead to socially excess deforestation as demonstrated theoretically in Fig. 5.2. This unfortunate impact is strengthened by corruption. It is one cardinal underlying factor in maintaining socially excess deforestation in the tropical

countries by maintaining the low-pricing system and additionally creating failures in the institutions of the market and state regulation. The market and the government are, after all, the two principal institutions controlling production and consumption activities in forestry (Fig. 2.1).

If we look at the system causality model of forest transition in Fig. 2.4, we can see how corruption is also undermining the effectiveness of property institutions, which means *de facto* open access conditions, and also the value of forests and community institutions. Underpricing creates a financing source for corruption in socialistic forestry. Corruption supports illegal logging and deforestation by artificially increasing the social opportunity cost of sustainable forestry (Bromley 1999).

Decentralization, devolution, and privatization of forest property rights have been ongoing in the tropics for some time, but on a larger scale in China, Vietnam, and Eastern Europe (Katila 2008; FAO 2005; White and Martin 2002). The success on this front has not been good (Sunderlin et al. 2008). A poor country, on the other hand, might not have the adequate funding to cover the *transaction costs* (Sect. 2.5) needed to close the open access to forests by establishing private or community property rights (Zhang 2000).

Next we will introduce empirical deforestation data as a test for our underpricing hypothesis above.

5.1.6 Testing the Underpricing Hypothesis with Empirical Data

According to Popper (1959), we cannot conclusively affirm a hypothesis, but we can conclusively falsify it. The validity of knowledge is tied to the probability of this falsification. For example, a very broad and general statement can never be wrong and thus does not bring us any insightful knowledge. The more specific a null hypothesis is, the higher possibility that the hypothesis can be falsified. For Popper, a scientific method is proposing bold hypotheses and exposing them to the severest criticism.

A good hypothesis or a good model needs a high degree of specification (Yu 2009), which may be missing here but will be at hand in the following modeling sections. Our model of Fig. 5.2 assumed simply that underpricing of stumpage and other goods and services of forest ecosystems leads to socially excess deforestation. According to Karl Popper (1959) we may try to falsify this hypothesis by introducing past empirical data. We may set our null hypothesis as follows. If the tropical forest area has expanded or remained unchanged in the past, our null hypothesis is falsified and our alternate hypothesis, underpricing of stumpage will cause deforestation, will not remain valid.

According to the FAO assessments tropical deforestation of natural forests has been continuing in 1990–2005. The largest deforested areas have been primarily in Latin America, followed by Africa and Asia-Pacific (Fig. 5.3; Photo 5.2). Deforestation has continued in the tropics at about the same rate, although it has somewhat slowed in the non-tropical regions (Chap. 1).

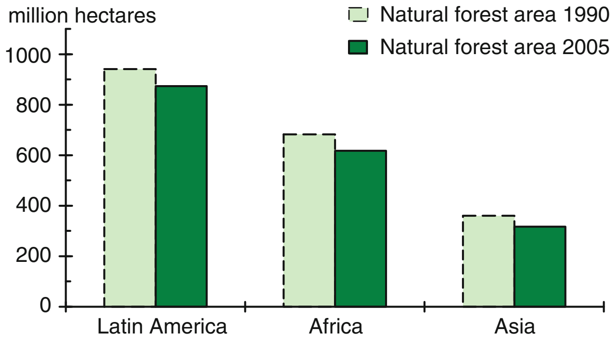


Fig. 5.3 Natural forest areas in the tropics by continents in 1990–2005 (Data source: FAO 2006)

Photo 5.2 Deforested mountains on Mindanao island in the Philippines in 1990 (Photo: Martti Saarilahti)

Deforestation is defined here as a change of forest cover into some other land cover formation (Photo 5.3), without the revival of forests by natural or artificial reforestation within a human planning horizon (a relatively short period). Deforestation occurs mostly by intentional human actions but may also result from unintentional action or by natural causes. Deforestation can appear as a final state of forest degradation, which can be described as deterioration of the forest due to decreasing biomass, which lowers the biological diversity and the productivity of soil (Box 5.1).

Photo 5.3 A deforestation site at a previous tropical forest (Courtesy of FAO)

Plantation forests cover about 3% of the total forest area in the tropics. Public bodies own only a minority of the forest plantations in Africa and Latin America but are major owners in Asia (Del Lungo et al. 2006). Forest plantations have been expanding in the tropics during the same time, when the natural forest area has been declining. Planted forests were in 2005 globally 50% in private ownership. The reliable data in the tropics are missing (Del Lungo et al. 2006).

Especially in the industrial plantation forests the stumpage prices are determined by the markets. Market-based stumpage prices have motivated the private forest owners to expand their plantation forests. They are, however, composed of smaller areas and are not full complements to natural forests, especially concerning biodiversity, carbon content and erosion protection (Sect. 5.3). Some corruption may have occurred in countries where the establishment of plantation forests is subsidized, e.g., in Indonesia (a comment by Dr. Jim Douglas of Australia).

We have earlier modeled scenarios of deforestation of tropical natural forests until 2050 (Fig. 5.5). There has not been deceleration of tropical deforestation in natural forests between 1990 and 2010 (Sect. 5.6.6) and we do not expect any major slow down until 2050.

We may conclude the findings of our empirical test that the area of tropical natural forest has been continuously decreasing. Therefore, we can falsify the null hypothesis and maintain our alternate hypothesis that underpricing of stumpage and other forest goods and services have among other underlying causes led to continuous deforestation.

Next we will review some announced causes of tropical deforestation.

Box 5.1 Definition of Deforestation and Net Change of Forest Area by FAO (p. 17 in FAO 2010a)

Figure 5.4 is a simplified model illustrating forest change dynamics. It has only two classes: forests and all other land. A reduction in forest area can happen through one of two processes: deforestation and natural disasters. Deforestation, which is by far the most important, implies that forests are cleared by people and the land converted to another use, such as agriculture or infrastructure. Natural disasters may also destroy forests, and when the area is incapable of regenerating naturally and no efforts are made to replant, it too converts to other land.

An increase in forest area can also happen in two ways: either through afforestation (i.e., planting or seeding of trees on land that was not previously forested), or through natural expansion of forests (e.g., on abandoned agricultural land, a process which is quite common in some European countries).

Where part of a forest is cut down but replanted (reforestation) or grows back on its own within a relatively short period (natural regeneration) there is no change in forest area.

For FRA 2010, countries were asked to provide information on their forest area for four points in time. This permits the calculation of the net change in forest area over time. This net change is the sum of all negative changes due to deforestation and natural disasters and all positive changes due to afforestation and natural expansion of forests.

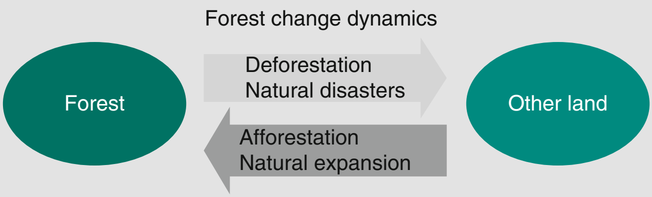


Fig. 5.4 A simplified model illustrating forest change dynamics (p. 17 in FAO 2010a)

5.1.7 Assumed Causes of Tropical Deforestation

FAO (2006) has identified the causes of extensive deforestation as follows:

- Population pressure,
- Agricultural expansion (Photo 5.5),
- Escalating demand for wood products,
- Illegal logging,
- Industrial development, and
- Rapid economic growth.

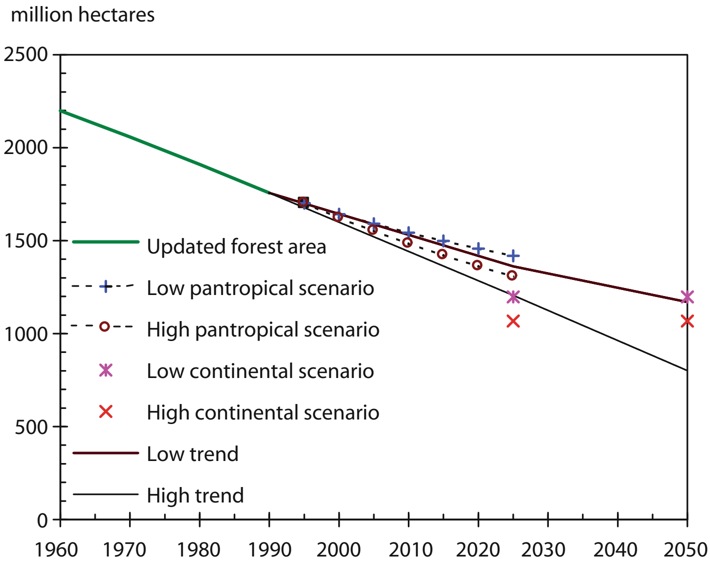


Fig. 5.5 Natural forest area in the tropics, 1960–2050 (Palo and Lehto 2005; Data sources: FAO 1999, World Bank 1998, United Nations 1998)

> By blaming population growth – and the subsequent land clearing for agriculture and scavenging for fuelwood by the masses – the public focus will be shifted away from the real cause of natural resource destruction in the developing nations. That cause is the ineffective – and often corrupt – governments with little interest in preserving the natural resources of their countries. (p. 126 in Bromley 1991)

Globally increasing population density has been connected to decreasing forest cover (Fig. 5.6). South Korea and Japan, however, are outliers from this general trend and they falsify the main FAO hypothesis. They both have high population densities, 488 and 349 inhabitants/sq. km, along with high forest covers, 63% and 69% of land area. Both countries have private forestry prevailing (69% and 59%) with low corruption (FAO 2010a). Both countries have overcome population pressure against forests by advancing law and order, protection of private property rights, technology, industrialization, urbanization, alleviating of poverty, increasing agricultural productivity, replacing of firewood with fossil fuels, and openness of trade.

We can agree with FAO only with illegal logging and a part of agricultural expansion as being relevant underlying causes. The other cause candidates by FAO have administrative underpricing of standing timber (stumpage prices) as a common underlying cause. This practice makes the social opportunity cost of deforestation artificially too low compared with the shadow stumpage prices appraised as residuals from the competitive markets of processed products. It facilitates clearing of forests for nearly any other purpose more profitable than sustainable forestry.

The roles of industrial development and rapid economic growth can be illustrated by Fig. 5.7. Under strong and clear private property rights increasing development

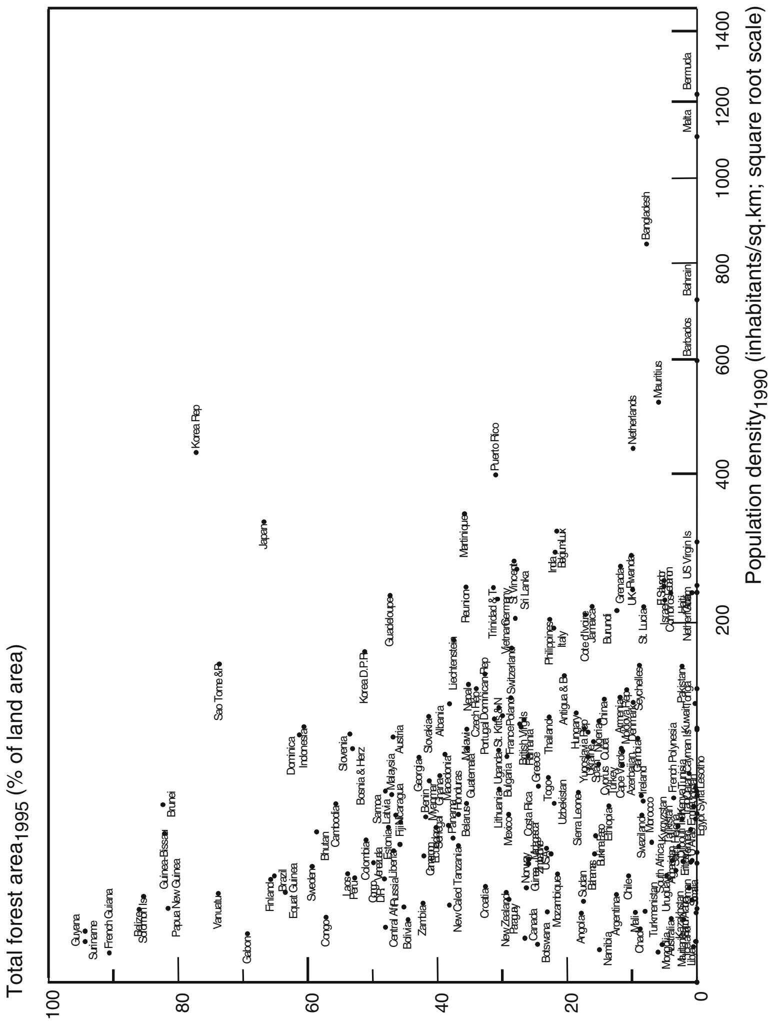


Fig. 5.6 Total forest cover and population density in 197 countries (Data sources: FAO 1999; United Nations 1998)

and growth would expand demand ("escalating demand") for forest products and raise the stumpage prices and lower the opportunity cost of sustainable forestry. Private forestry countries can more easily than socialistic forestry countries benefit from increasing development. Finland provides an illustrative case study of this in our book (Sect. 4.6).

Kuznets hypothesis of Fig. 2.3 assumes that forest transition will take place along with the expansion of economic development and increasing stumpage prices. With empirical data from 166 countries (Fig. 5.7) we are able to falsify the statement that increase of GNP/capita has no increasing effect on forest cover.

In fact, if Ireland is assessed at the bottom of the U-shape of the observations, to the right and higher up of Ireland there are 19 countries. They all belong to low corruption cases (Map 5.1). The great majority (14) of them practice private forestry, only Brunei, Canada, New Zealand, Switzerland, and the Bahamas rely on socialistic forestry. Private forestry operates mostly under competitive stumpage markets, which motivates intensification of forest management.

We can strengthen the empirical support of private forestry with a European experience. Forest resources have been growing since 1951 in the 18 countries of Europe, excluding the previous Soviet Union countries (Fig. 5.8). The net annual increment has continuously exceeded annual fellings. Out of the 18 countries, 13 have practiced primarily private forestry (FAO 2010a). The comparison of increment with fellings provides a stronger and more valid indicator of forest transition than increase in forest area, which does not tell us anything about the change in growing stock (Box 4.1).

This development contrasts the deforestation of natural tropical forests under the socialistic forestry countries of the tropics (Fig. 5.5). We may interpret from this that under increasing economic development and private forestry we cannot falsify the Kuznets hypothesis of Fig. 2.3. Private forestry, or at least private usufructs as in China (see below), seems to be a necessary, if not a sufficient, condition for the realization of the Kuznets hypothesis of forest transition.

We can introduce also more direct evidence of the deforestation impact by socialistic forestry in Fig. 5.9, which depicts the distribution of 25 of the 30 most forested countries in 2002–2008 in the categories of a decrease, increase, or no change in total forest area. Among the socialistic forestry countries we can see that in 18 countries total forest area decreased, in 7 countries increased, and no countries appeared in the category of no change.

In the remaining three categories of private forestry no change in forest area was prevailing and a decrease in forest area category had the least frequency. With this empirical evidence we may falsify the null hypothesis that socialistic forestry is not supporting deforestation and maintain the alternate hypothesis that socialistic forestry is supporting deforestation. Respectively, we may falsify the null hypothesis that private forestry is supporting deforestation and maintain the alternate hypothesis that private forestry is supporting forest transition.

The *Public Choice Theory* supports rent seeking and corruption by government office holders under strong pressures from the vested interests (Sect. 2.5). This is a final cause for deforestation in the tropical countries according to Bromley (1999).

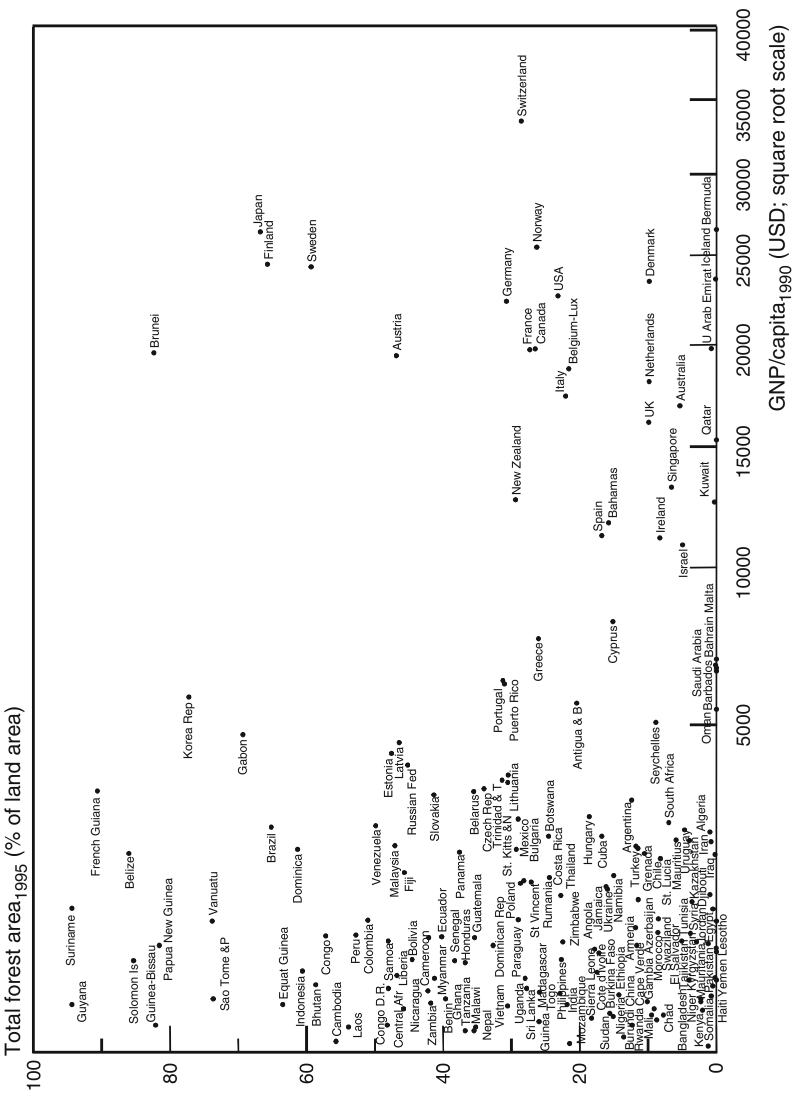


Fig. 5.7 Total forest cover and income per capita in 166 countries (Data sources: FAO 1999; World Bank 1998)

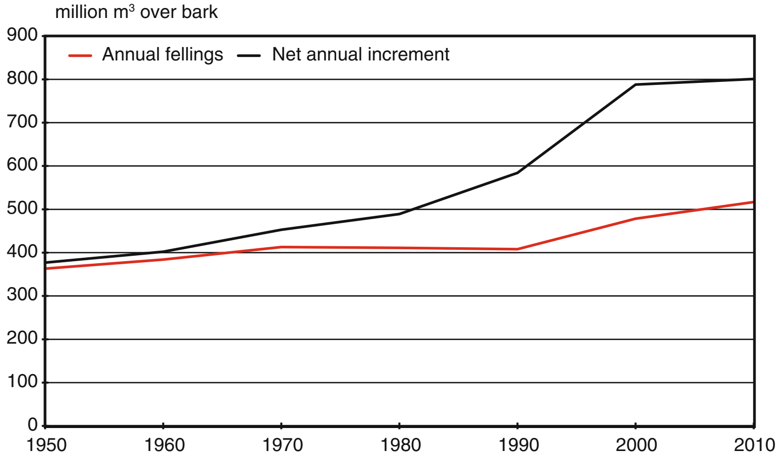


Fig. 5.8 Change in forest resources in non-Soviet Europe from 1950 to 2010 (Kuusela 1994; Michalak 2011)

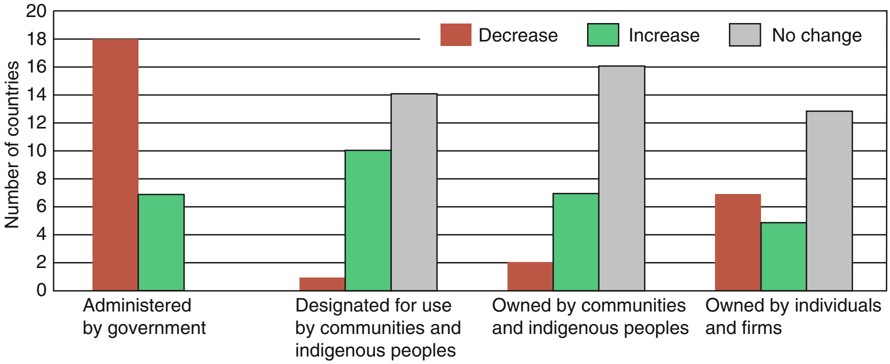


Fig. 5.9 Forest area dynamics from 2002 to 2008 in 25 of the 30 most forested countries in the world according to four tenure categories (p. 9 in Sunderlin et al. 2008)

The problem of corruption is also identified in numerous natural resource-rich developing economies, such as crude oil and mineral-producing countries (Auty 2001).

We shall receive further empirical evidence of the role of corruption as an underlying cause of deforestation in Sects. 5.2 and 5.3. In our multiple variable regression analyses corruption appears as a statistically significant independent variable of deforestation along with four or five other socio-economic variables both with the forest area data of 1995 and 2005.

Under corrupt conditions *de facto* open access conditions are created to expand forest degradation and deforestation (Douglas and Simula 2010). This is the real deforestation tragedy of open access (Hardin 1968). The effectiveness of governance

is decreased and no competitive markets in forests appear. Socialistic forestry implies government and market failures with consequent open access to the public forests (Palo 1997, 2000).

Market failures are generated by weakly defined property rights on the tropical forests and their various goods and services. The intrinsic fragility of tropical forest ecosystems is inclined to cause the irreversibility of deforestation. Weak property rights along with their weak enforcement and often a large scale undermine the regulative institutions by the tropical governments. As a consequence, the forests become *de facto* open access resources and over-utilized, with socially excessive deforestation (Reis 1999).

Underpricing of forest (Fig. 5.2) is a core underlying cause of socially excessive deforestation. It facilitates a public financing source for corruption. Expanding exports (at the top center of Fig. 2.4) of agricultural and forest products along with corruption and illegal logging amplify these deforestation effects. When corruption is rampant and law and order with good governance are missing, the context motivates contractors and local people in illegal expansion of logging. Even legally protected forests can be degraded and deforested in a large scale.

Socialistic forestry has a relevant motive – financing of corruption – to underprice standing timber and the whole forest.

Next we will turn to the role of stumpage in financial accessibility for logging.

5.1.8 Higher Stumpage Prices Contract Logging Area

Johan Heinrich von Thünen (1826) was a farmer and an amateur economist. He was interested in maximizing his land rent by optimally locating the different lines of farming production. He assumed that haulage costs depend on the distance to the market and different kind of products. According to him, the gain from farming per unit area or locational rent decreases with increasing distance to the market.

The minimum price estimate of a commodity at a mill is calculated by locational rent, haulage costs, and fixed processing costs. The profit is then the difference between the market price and the costs. The idealized circular patterns of agricultural land use zones around a single market illustrates von Thünen's model. Locational rent is to be understood as the equivalent to land value. It corresponds to the maximum amount a farmer could pay for using the land, without incurring losses.

Heikinheimo and Lehikoinen (1981) illustrated a simplification of von Thünen's (1826) model of the theoretical effects of the changes in logging and haulage costs on the stumpage price to a forest owner. They also exemplified the elasticities of stumpage prices on the shifts in export prices and different number and locations of forest industry plants. In their empirical test transportation costs explained 65% of the spatial variation of stumpage prices of pine pulpwood in Finland. The authors excluded demand aspects from their models.

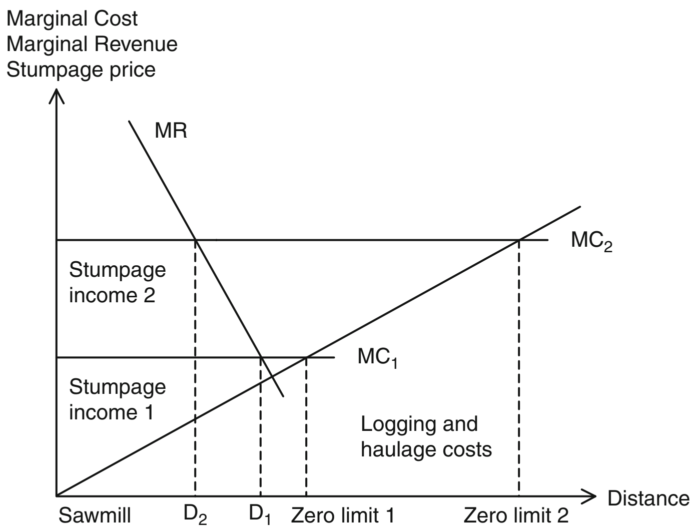


Fig. 5.10 Dynamics of variable stumpage prices on economic accessibility of logging under fixed costs of logging, haulage and fixed demand

We are here interested in the elasticity of logging and haulage distance from a processing plant, e.g., a sawmill, as a function of stumpage price. The stumpage price, logging and haulage costs, and ex-mill prices of logs or marginal costs and revenues are depicted along the vertical axis. The distance of haulage to the mill and the quantity of logging both increase along the horizontal axis (Fig. 5.10).

We may consider first the point of view of a sawmiller (Photo 5.4) as a timber buyer. The ex-mill costs of logs in natural forests consist of three major components: fixed costs (overhead), the costs of logging and haulage, and stumpage price. The further on the periphery logging is practiced, the higher are the costs of logging and haulage and the less can be paid for the forest owner as a stumpage (Fig. 5.10).

We further assume that the sawmiller is in a monopsony situation: he can determine the stumpage price at various distances from the mill. The sawmiller tries to maximize his profit. Accordingly, he will make an appraisal of stumpage as a residual in a chain of costs from the sales price of sawnwood.

He knows the price of sawnwood ex-mill. He will deduct costs of sawmilling and overhead for the procurement and working capital as well as his target for profit from it. The residual equals the delivered log price ex-mill. Next the sawmiller deducts costs of logging and haulage from the ex-mill price and arrives to a final residual that we may call his willingness to pay as stumpage price at different distances from the sawmill. The profit target can be set high enough to facilitate corruption. Consequently, the residual stumpage 1 will respectively remain at a lower level than a reference from the competitive market.

Photo 5.4 A sawmill in the Philippines in 1990 (Photo: Martti Saarilahti)

Low stumpage price would mean low value of natural forest and high social opportunity cost of sustainable forestry (Fig. 5.2). It would motivate local agents to continue conversion of natural forest into cattle ranges and agricultural fields with higher profitability than sustainable forestry. Low stumpage prices would maintain the major source of financing corruption as a difference between the higher shadow market stumpage price and the lower administratively set stumpage price.

We illustrate next the last phase of the appraisal in Fig. 5.10. Naturally, competition from another sawmiller or a log exporter can complicate the situation and raise the stumpage price. Here, however, we maintain the assumption of the sawmiller's monopsony. This is realistic in many cases in tropical countries. Stumpage price 1 would decrease along the increase of the costs of logging and haulage costs. Their sum is denoted as ex-mill price. It can be viewed as marginal cost curve (MC_1) or supply. The intersection of it with a fixed marginal revenue curve (MR) would indicate the optimal distance to the sawmill (D_1) and the optimal logging quantity.

Under socialistic forestry the state has the monopoly as a seller of logs for this sawmill. If the Forest Service would remain non-corrupted, it could raise the stumpage from stumpage price 1 to stumpage price 2 in order to increase the incoming revenue or perhaps try to establish forest management intensification profitable. This would have a corollary transfer from MC_1 to MC_2 under constant costs of logging and haulage and constant fixed costs. The intersection of MC_2 and the constant MR would indicate the new optimal distance D_2 to the sawmill and the new optimal logging quantity (Photo 5.5).

When the stumpage prices under socialistic forestry are administratively set at low level of stumpage price 1, harvesting of timber can be extended further from the

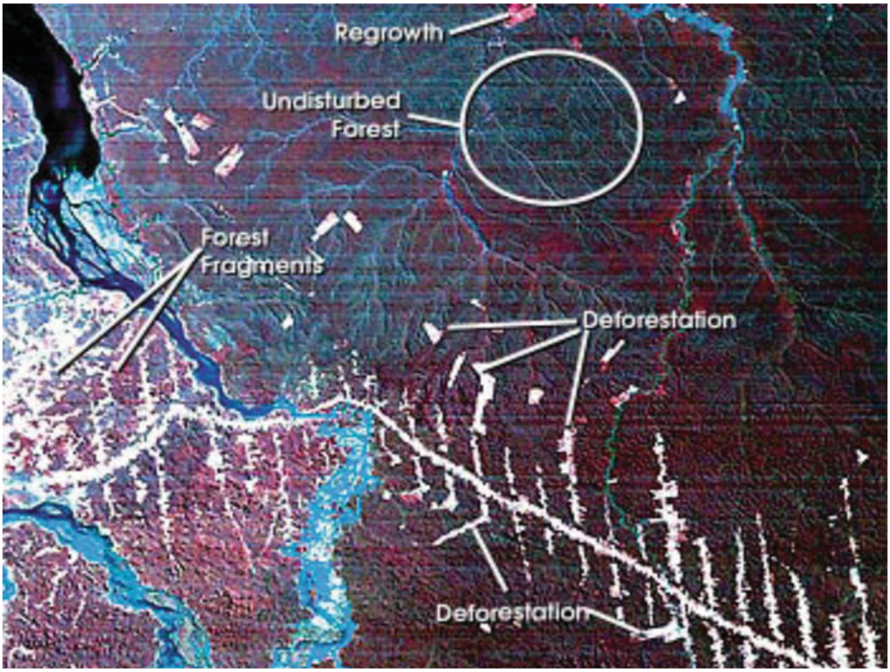


Photo 5.5 A satellite picture of a road network in a tropical forest in Rondonia, Brazil. Access by road is expanding deforestation along the roads (Photo: courtesy of FAO)

mill than under higher stumpage price 2 (Fig. 5.10). Accordingly, we may deduce an assumption that higher stumpage prices would contract the logging distance to the sawmill under fixed demand. That would conserve more natural forests for sustaining biodiversity and carbon stocks.

Simultaneously, the higher stumpage prices would improve profitability of sustainable forestry and decrease the social opportunity cost of sustainable forestry. Most important would be that higher stumpage prices would reduce the financing source for corruption. Reduced corruption would reduce deforestation. We shall see below that an assumption that high stumpage prices support high value-added products in forest industries can be maintained after empirical testing.

Under no marginal revenue (demand restriction) restriction the higher stumpage price would expand logging from zero limit 1 to zero limit 2. For a forest owner it would be rational to sell timber as far as positive stumpage price would be available.

So far we have studied the effects of socialistic forestry in the tropics. Next we shall briefly review, for comparative purposes, two socialistic forestry countries, Russia and Canada, two industrialized countries located in the boreal coniferous zone. A reference will be given also to China located mostly on the temperate forest zone with interesting transition from pure socialistic forestry toward private forestry.

5.1.9 *Socialistic Forestry in Russia and Canada Versus Transition in China*

We restricted this Sect. 5.1 so far to the tropics, because tropical deforestation is such a hot global problem. However, we may ask, whether socialistic forestry is operated somehow more effectively and efficiently outside the tropics?

In Russia all forests belong to the public ownership (FAO 2010a) and stumpage prices have been centrally set lower than the competitive market (Petrov and Lobovikov 2001). Therefore, Russia has been typically practicing socialistic forestry. Timber has been sold primarily on a concession system with administratively determined low stumpage prices of 6–7 USD/m^3 (in Finland 44 USD/m^3) (Ottitsch et al. 2005; Palo 2007). Earlier, even lower stumpage prices were reported by Petrov and Lobovikov (2001).

Russia's rank was 154 in 2010 as indicated by the Corruption Perceptions Index. The index identified only 20 more corrupted countries than Russia in the world (Transparency International 2010). Accordingly, Russia is under high corruption pressure (Map 5.1), which maintains underpricing of stumpage and increases financial risks in timber harvesting and in investments in forest industries.

It was lately assessed that under socialistic forestry in Russia 10–35% of all the production of roundwood was illegal. In the worst areas in the most eastern remote territories about half of logging has been assessed as illegal (Metla 2011; Kotlobay and Ptichnikov 2002). Major increases in stumpage prices toward markets with its benefits are most unlikely under the prevailing socialistic forestry regime. Ad hoc devolution of Russian forests under heavy corruption would lead to an even worse situation.

Since 2004 Russia has tried to curb illegal logging on own and by participating in the ENA-FLEGT process (Europe and North Asia Forest Law Enforcement, Governance and Trade). It is run by the World Bank, IUCN, and WWF jointly with various national partners. A system of remote sensing was constructed to redress illegal logging in 180 million ha of forests. Also a novel national system for scaling is under development. Expansion of forest certification has been slow – only 26 million ha so far (Metla 2011). Under socialistic forestry and heavy corruption, illegal logging continues in Russia.

This is the Gordian Knot of Russian forestry behind the curtains of the export duties, which were considerably raised during 2006–2011 (Palo 2007). Russia and Finland are neighboring countries (Map 1.1). Russia has about 40 times the volume of the standing timber as Finland. Russia can annually log only three times more than Finland.

Finland is a big power in the exports of forest products, while Russia is not. The gross value added of the forest sector was USD 10 billion (5.7% of GDP) in Finland and only USD 7 billion (0.8% of GDP) in Russia in 2006 (FAO 2009). Finland relies primarily on private forestry and the market, Russia on socialistic forestry and forestry "Gosplan."

Canada has 8% of the total forests in the world, while Finland has 0.5%. State and federal ownership of forests is 92% in Canada (FAO 2010a). A concession system has been practiced in timber sales in Canada with earlier administrative stumpage prices of 11–13 USD/m^3 set by the individual states (provinces) (Haley 2001). Accordingly, Canada has practiced socialistic forestry along with Russia. Canada has generated stumpage income as an annual average USD 1.6 billion for 286 million ha of its public forests (CCFM 2006) and Finland as an annual average USD 2.5 billion for 22 million ha of its total forests (72% private) in 2001–2005 (Ylitalo 2010).

The gross value added of the forest sector in 2006 was USD 32 billion in Canada and USD 10 billion in Finland. The gross value added in the forest sector as a share of GDP was 2.7% in Canada and 5.7% in Finland (FAO 2009).

Finland can compete with Canada for world leadership in the net exports of forest products. Canada is exporting mostly low-valued forest products, such as lumber, logs, newsprint, and pulp, while in Finland high-value papers and paperboards dominate the exports. Low stumpage prices have not motivated the Canadian corporations to increase the degree of processing, although this has been the policy aim of the low stumpage prices. Finland has had the opposite situation – high stumpage prices with a high degree of processing.

The value of paper and paperboard exports was USD 9 billion in Canada and USD 11 billion in Finland in 2008. The respective unit values were 808 USD/ton in Canada and 908 USD/ton in Finland. Sweden has 0.7% share of the global forest area. Sweden had exported paper and paperboard by USD 10 billion with a unit value of 984 USD/ton in 2008. The United States has less forest than Canada (304 million ha) but exported paper and paperboard with a value of USD 9.8 billion in 2008 with a unit value of 840 USD/ton. Russia has exported paper and paperboard of USD 2 billion with a unit value of only 685 USD/ton in 2008 (FAO 2010b).

Canada and Russia have practiced primarily socialistic forestry with low stumpage prices, while Finland (72% private), Sweden (76% private), and the United States (57% private) practice primarily private forestry with high stumpage prices. A null hypothesis that low stumpages prices support exports of high value-added forest products was falsified. An alternate hypothesis that high stumpage prices support high value-added products in the exports of forest products remained valid.

The United States has challenged Canada's practice of underpricing the stumpage. The US-Canada softwood lumber dispute is among the most significant and enduring trade disputes in the history of the two countries. The heart of the issue lies in administrative pricing of the stumpage by the Canadian provincial governments and not market pricing, as is the case in the United States. It claims that the provision of timber at below-market prices in Canada constitutes an unfair government subsidy in exports to the United States against the domestic sawmills. According to the US laws, a countervailing duty tariff to offset the subsidy can be set (Abby and Foster 2008; Sedjo 2006).

The London Court of International Arbitration decided that Canada has acted against the 2006 Softwood Lumber Agreement with the United States. The Court concluded that if Canada will not correct the practice the United States is entitled to

demand a countervailing duty tariff of USD 60 million. This dispute concerned primarily British Columbia and the sawmills of the northwestern United States. Canada lost a similar case earlier and more suits are coming (Maaseudun Tulevaisuus 2011; Abby and Foster 2008).

Canada is a democratic and a low-corruption (Map 5.1) country. This situation has facilitated a widely practiced participative planning, which is unique among the socialistic forestry countries. This practice has improved the image of Canada's socialistic forestry both at home and abroad. Due to the pressure from the United States, various provinces, e.g., Ontario, have gradually transformed their stumpage pricing systems closer to the respective market prices (Yang et al. 2006).

Russia and Canada share a few similar features as consequences of socialistic forestry. Sustainable forestry has not been financially profitable. Canada has produced criteria and indicators of sustainable forestry with a number of achievements as measured by various indicators (CCFM 2006). But the most important indicators of reliable changes in forest area, growing stock, its age distribution, and carbon stocks are missing in both countries. Low stumpage prices also allow for high logging and haulage costs with socially excessive remote logging (Fig. 5.10), while no remarkable intensification of forest management even in the best economic-geographic locations has taken place.

Russia reported for 1990 a total forest area of 809 million ha and the same for 2010. The reported plantation forest areas were, respectively, 13 and 17 million ha. Accordingly, natural forest area had declined by 3 million ha. Canada, on the other hand, reported for 1990 and 2010 the same total forest area of 310 million ha as well as the plantation forest areas, respectively, of 1 and 9 million ha. Accordingly, the natural forest area had decreased by 8 million ha (FAO 2010a).

Both Russia and Canada reported to FAO in March 2009 that their monitoring systems are inadequate to indicate reliable estimates of changes in forest areas and growing stocks (Sect. 5.6.6). Therefore, no reliable data have been provided on changes in forest resources of their joint 28% of the global forest area.

China has 5% of the total forests in the world. It has 32 million ha of plantation forests. This is much more than in any other country in the world. The natural forests are owned by the state but the usufructs in the plantation forests have been since 1981 devolved to local families, villages, and companies. Although the state has maintained the property rights to the land, the usufructs along with rising prices, subsidies, and tax holidays have motivated the locals to expand plantation forests rapidly. The major formal institution was the 1984 forest law, which created the private usufructs (Richardson 1990).

The forest law was amended in 1998. The property rights have been clarified through forestry landowner's re-titlement. Significant forces have been provided to protect economic rights in the forests and to solve the inherent disputes. Timber trade has been gradually liberalized. The de-collectivization of collective forestry land has progressed through the Household Responsibility System and the Shareholding System. De-centralization of the state-owned forestry land has occurred dissolution of the management authority and budget regime (Zhang 2000).

Most logging in the natural forests in China has been banned since 1998 due to excess flooding and other environmental problems. Accordingly, China was the world's largest importer of industrial roundwood in 2006 with 33 million m^3. Deforestation continued until 1980, but the total forest area has increased by 24 million ha and the forest cover of the total land area from 17% to 21% during 1990–2005 (FAO 2006, 2009; Kant 2001; Mather 2007).

China reported total forest areas of 157 and 207 million ha for 1990 and 2010, respectively, including plantation forest areas of 42 and 77 million ha. Accordingly, the natural forest area/increased by 15 million ha (FAO 2010a). We may conclude that the transition of the usufruct to the locals with markets for timber, but not the right to land, has already changed the character of the traditional socialistic forestry.

The Chinese case illustrates the Kuznets hypothesis of Fig. 2.3: the market-based private forestry has expanded plantation forests. The deflated timber procurement price index did stagnate from 1950 to the late 1970s, when the price was liberated. Since then it increased fourfold until 1990 but due to an increased supply from plantation forests and from imports the index somewhat decreased until 1995 (Zhang 2000). The gross value added of forest sector in China was USD 41 billion or 1.3% of GDP in 2006 (FAO 2009). This was six times more than in Russia. Mather (2007) in his study on forest transition in China did not clarify the roles of transformation of usufructs and price liberation.

A critical evaluation of the Chinese forestry statistics found serious data discrepancies in all major statistics. Most of the remaining natural forests are very young. Significant illegal logging has been observed with consequent depletion of the meager commercial growing stock. Consumption of fuelwood has not yet declined. The continuous expansion of plantation forests seems also to coincide with problems of property rights, competing land uses, productivity of labor, environmental limitations, costs of land, and other fixed costs (Bull and Nilsson 2004).

China had a rank 57 in 2001 and 78 in 2010 as measured by the Corruption Perceptions Index among 178 countries (Transparency International 2010). This means that corruption in China has increased over these 9 years and that the country remains rather corrupted, which may explain the above problems in illegal logging and discrepancies in the statistics.

As a conclusion, Russia and Canada both practice socialistic forestry, which cannot falsify the hypothesis on the failure of socialistic forestry worldwide. China has transformed its previous socialistic forestry in plantation forests toward private and community forestry with remarkable success in the expansion of its plantation forests. We were able to maintain our hypothesis that socialistic forestry supports non-sustainable forestry and private forestry supports sustainable forestry.

5.1.10 Discussion

Hofstad (1997) analyzed the issue of balancing public and private in forest policy by comparing socialistic forestry in Mozambique with private forestry in Norway with the aid of some theoretical considerations. Norway had reached sustained yield

forestry but in Mozambique deforestation was continuing. He considered the state important in establishment of property rights to "all sorts of forest resources and such regulation is probably a necessary but not sufficient condition for sustainable forestry" (p. 156 in Hofstad 1997).

Hofstad continued that many market failures must be corrected by public intervention but it should not be assumed that public choice is necessarily more fair and democratic than the market due to strong vested interests. He did not refer to low administratively set stumpage prices and corruption in Mozambique.

Wunder and Verbist (2003) made a comprehensive and competent review on the impact of trade and macroeconomic policies on deforestation. One of their conclusions was that many "good" development policies for economic growth and poverty alleviation appear bad for forest conservation. Another conclusion was that extra-forestry sector policies prove to be much more important for deforestation than forest policy proper. Here is a point for critical comment. The authors did not consider the roles of undervaluation of stumpage and consequent corruption and deforestation. It was surprising that in the context of analyzing deforestation in Indonesia, neither corruption nor underpricing was mentioned.

Hirakuri (2007) made a comparative analysis of the forest administrative systems in Brazil and Finland without any explicit theory. She considered Finland as "an exemplary case of a successful model" for Brazil (p. 219 in Hirakuri 2007). She reviewed forest resources, forest laws and state regulatory institutions in both countries. She observed no more deforestation in Finland but a continuous and large deforestation in Brazil. She did not refer to different levels of stumpage prices and forest values. However, she appreciated the cultural value of forests in Finland and observed its lack in Brazil.

Hirakuri mentioned corruption in Brazil in one sentence: "Corruption has been one of the major reasons for difficulties in enforcing the forestry laws" (p. 242 in Hirakuri 2007). She reviewed briefly forest land tenure in both countries. "Forest ownership in Finland is based on private smallholdings and on secure forestland tenure. Quite the opposite, Brazilian forest ownership is based on private large holdings and insecure forestland tenure" (p. 241 in Hirakuri 2007).

Sunderlin et al. (2008) reported similarly that the public ownership of forests in Brazil was 307 million ha in 2002 but only 114 million ha in 2008. They reported that in 2008 communities and indigenous people owned 109 million ha and individuals and firms owned 198 million ha. On the contrary, FAO (2010a) reported 81% in public ownership and 19% in private ownership in Brazil as well as that public administration held 63% of the management rights and local communities 37%. We have considered the latter source more relevant. (A similar discrepancy occurred in China by the two sources.) This finding perhaps describes the insecure forest tenure situation both in Brazil and China. In any case, socialistic forestry prevailed in Brazil at least until 2002, if not longer.

Kauppi et al. (2006) studied forest transition in 50 countries with largest forest areas in the world based on FAO (2006). They illustrated in 12 country cases, primarily from industrialized countries, how the Kuznets curve transition had taken place along with increasing incomes above USD 4,600 of GDP per capita/year. They believed that the forest transition will take place in a similar way in the tropical

countries. Unfortunately, the authors paid no attention to prevailing socialistic forestry and corruption in the tropics. The authors concluded that their insights provide grounds for optimism about the prospects of returning forests. This was too great a promise from a paper neglecting the roles of property rights and competitive stumpage prices.

I introduced the concept of socialistic forestry in 1997. I recalled a special issue of *Unasylva* in 1993 on forestry laws and policies with no reference on the complementary role of markets to government policies. A textbook on international politics provided another case of omission on the role of markets (Humphreys 1996). Socialistic forestry as the fundamental problem behind tropical deforestation had been largely neglected as a study object. As a conclusion I wrote that the time has come to challenge this long-lived paradigm of socialistic forestry but there is no relevance to transit from plan to market overnight (Palo 1997).

According to our findings of the theoretical reasoning the administratively set low stumpage price is the main source of financing corruption. A simple solution to check corruption would be to remove this financing source by raising the stumpage prices on the levels that could be appraised as residual shadow prices from the markets (Box 6.1). However, corrupted administrators are not motivated to the enforcement of this change. Therefore, as a first remedy, corruption should be reduced at a workable level.

In 1979–1980 I had a mission by FAO to the Philippines, which was practicing socialistic forestry. As a consultant I was surprised by the Philippine situation: all possible formal forestry institutions with 1,500 university educated foresters plus a high number of rangers and forest guards were unable to stop illegal logging and deforestation.

The junior foresters told me in a number of formal interviews that their hands were bound from any reforms, because their bosses were severely corrupted. I even met the perhaps most corrupt civil servant of that time in the Philippines (Box 5.2). Klitgaard (1988) described a case of totally corrupted Internal Revenue Bureau in the Philippines and how an effective attack against corruption was enforced there.

Decentralization and devolution of public forests under corruptive conditions can even lead to more rapid deforestation and forest degradation (Laarman 1996). A dogmatic, ideological, neo-liberal orientation should be avoided. Rather an optimum mix of markets and policies should be strived for (Stiglitz 2002).

Corruption facilitates illegal logging, forest degradation, and deforestation. Socialistic forestry has been developed for maintaining this system in countries where public forests comprise all the forests or the majority of all the forests. Under such circumstances public forests become *de facto* open access resources undermining the market and the state regulative institutions.

Socialistic forestry has turned out to be a real tragedy of open access to natural tropical forests and continuous deforestation resembling the environmental deterioration problem described by Hardin (1968) at the broader scale of open access to all natural resources. In the tropical countries erosion-sensitive conditions prevail. This increases a risk that environmental deterioration after deforestation is escalated and no resilience of forests takes place.

Box 5.2 A Forestry Field Project by FAO Revealed Corruption in the Philippines in 1979–1980 (Palo 1980)

No consultant or other project workers wrote about corruption in the early days. Corruption was a taboo in the FAO circles. I had heard whispering about its role in logging in Malaysia in 1975, but in the Philippines during Ferdinand Marcos' dictatorship corruption was running so wild that I personally became acquainted with it.

In 1979–1980 I consulted on a FAO project on "Philippines Multiple Use Forest Management." It had been started in 1978 and had a duration of 1 year and 10 months. It was a follow-up to a previous similar project. The project had been staffed by a project manager from UK, an expert in agroforestry, and an associate expert in forest management. An expert in the field organization and procedures had consulted the project earlier.

Along with this project some other projects were run by FAO in the Philippines. "Centre for Forestry Education, Research and Development for the Asia/Pacific region" was executed by FAO and financed by SIDA, the Swedish official development agency. Another project by FAO concerned "Assistance to the Preparatory Phase of National Forest Inventory." One further project by FAO existed on "Coconut Timber and Wood Utilization."

In addition to the FAO forestry projects some others had existed earlier or were running simultaneously. The first nationwide forest inventory in 1962–1967 had been funded by the United States. "Training Center for Reforestation and Erosion Control" had been financed by Germany. International Labor Organization (ILO) and Finland had joined forces on "Appropriate Technology in Philippine Forestry." There had been also a Japanese project on afforestation and an ASEAN/New Zealand project on pine plantations.

As a consultant I prepared a development plan for forest sector statistics in the Philippines. My primary recommendation was to complete as soon as possible the ongoing national forest inventory. This had the first priority due to the rapid ongoing deforestation and forest degradation. I also proposed a new information center in the Bureau of Forest Development.

A.J. Browning of the United Kingdom, my project manager, had arranged a meeting with Edmundo V. Cortez, the Director of the Bureau. We went together to meet Cortez. The waiting room for his office was crowded. We had to wait for a half an hour, although only a few years back Cortez had worked as an assistant to Browning on another FAO project. I got the impression that all issues were concentrated to the Director.

The office of the Director was larger than any office I had seen before and the walls decorated with beautiful panels of tropical woods. I handed my consultant report to Cortez. I reminded him about the low level of stumpage prices, which were fixed by law. They caused waste of timber and deforestation. Higher market-relevant prices could bring considerably increased revenues to

(continued)

Box 5.2 (continued)

the government and install a forest policy instrument "towards certain forest policy objectives" (eradication of corruption). I gave another main recommendation to complete the national forest inventory as soon as possible.

Cortez promised to enforce my recommendations. However, because he was highly corrupted himself both recommendations had been against his personal future gains. As one of the most corrupted bureaucrats he was immediately sacked in 1986, by President Corazon Aquino, when the democratic revolution took place after the lengthy dictatorship of Ferdinand Marcos.

As a consultant I was surprised by the Philippine situation: all possible formal forestry institutions with 1,500 university educated foresters plus a number of rangers and forest guards were unable to stop illegal logging and deforestation!? The junior foresters told me in a number of formal interviews that their hands were bound from any reforms, because their bosses were severely corrupted.

However, strong intellectual resistance against corruption in logging appeared, especially among some of the university professors (Communication with Professor Olli Saastamoinen of the University of Eastern Finland, who worked in the Philippines for a couple of years on the latter half of the 1980s).

I am confident that, under the circumstances those days in the Philippines, my consulting report had no de facto impact on the development of forestry in the Philippines. At least, corruption (rank 134), illegal logging, and deforestation did continue for many years at the same pace as before (Transparency International 2010; Saastamoinen 1996; FAO 1993a, 2006).

During this mission I saw with my own eyes ongoing deforestation with serious consequences and also a most corrupted local forester. This experience awoke my personal interest and motivation on the role of corruption in deforestation and on modeling underlying causes of tropical deforestation.

We may ask if, at the end of the day, there is anything left for further investigation about the underlying causes of tropical deforestation of natural forests? Naturally, we shall try to make quantitative modeling of it with corruption as one of the independent variables that will be specified by our system causality model of forest transition (Sects. 5.2, 5.3, and 5.4), which we could not falsify by this sub-study.

> For as I hope this book shows in regard to corruption, policymakers and citizens are not helpless. There are things we can do about even this most difficult of problems (p. 210 in Klitgaard 1988)

5.2 Causes of Deforestation in Poor and Less Poor Tropical Countries

5.2.1 Introduction

The purpose of this section is to contribute toward the UN Millennium goal of environmental sustainability by increasing understanding of the underlying causes of deforestation in the tropical countries divided into poor and less poor tiers.

"Tragedy of Socialistic Forestry" (Sect. 5.1) introduced the principal underlying cause of tropical deforestation, namely the prevailing public ownership of forests, subsequent underpricing of stumpage, and corruption. Artificially low stumpage prices make the social opportunity costs of deforestation so low that clearing of forest for just about any purpose is more profitable than sustainable forestry.

However, we may also analyze tropical deforestation as a complex, dynamic, multi-sector, and multilevel phenomenon (Sect. 2.7; Fig. 2.4). The visible local actors of deforestation are composed of such agents as colonists, agriculturalists, shifting cultivators, cattle rangers, fuelwood gatherers, industrial loggers, and infrastructure developers. They act according to relative prices, taxes and subsidies, or coercion applied by the national or international actors.

The real causes of deforestation are underlying these local level direct actors (proximate causes). In order to slow down deforestation we have to deal with these underlying causes (Palo 2000; Geist and Lambin 2002; Uusivuori et al. 2002).

Naturally, the direct local actors of deforestation have their individual motivations and goals that may be called the proximate causes of deforestation. Profit maximization and survival are representative examples of such goals. In a brief way, we may state that tropical deforestation is continuing at a non-decreasing pace (Fig. 5.3), because for economic agents deforestation is more beneficial than maintaining natural forest cover or practicing sustainable forest management. A low monetary value of natural forest acts as a key factor to make the social opportunity cost of sustainable forestry high.

Deforestation is described here as a three-level, multi-sector process, where factors at the different levels are organized in various cause-effect chains. In the specification of this modeling the local agents are excluded. The visible local agents are clearing the forests, but it is not possible to control them directly by command.

We concentrate on some key underlying factors at the national and international levels, which can be more effectively used to control deforestation. The specification of the model is therefore guided by this rationale (Sect. 2.7) and by the availability of valid and reliable data.

Special attention will be paid to the roles of plantation forests and corruption in deforestation modeling. Amacher (2006) concluded that forest economists know too little about corruption and its implications for forest policy. Some other socioeconomic and ecological factors accompany these analyses.

We have found numerous studies on deforestation modeling (e.g., Sect. 2.2; Barbier et al. 2005; Palo and Lehto 2005), but hardly any of them have coped at the national level with plantation forests, poverty, and corruption among the underlying causes.

We selected natural forests as our dependent variable in deforestation modeling and excluded plantation forests, because plantation forests are not full substitutes for natural forests. We included plantation forests among our independent variables. We shall make a separate modeling of the expansion of plantation forests in the tropical countries (Sect. 5.3).

We focused our analyses on the national level due to three criteria. First, national governments create the formal institutions to govern land use and land cover changes. A number of global and international institutions also exist for this purpose, but the degree of their enforcement is up to the national governments. The relevant data for deforestation modeling are also available mostly only at the national level.

In this section we first specify our deforestation model and identify the empirical data, then estimate models for less poor and poor countries, and finally discuss our findings at the end of the section.

5.2.2 Model Specification and Data

It makes a difference which concept of forest is applied in modeling (Palo 1999a; Angelsen and Wunder 2003). Here we will use the concept of natural forests, which covers the different types of tree formations, with the exception of plantation forests. This therefore includes: rain forests, moist, semi-moist, semi-arid, arid, montane, and cloud forests in the tropical countries.

The forest and tree concepts used are from the FAO FORIS database (Marzoli 1995). Instead of absolute variables (e.g., forest area) we selected ratio variables (e.g., forest area/non-forest area). We also consider stock variables more reliable than change variables.

We selected the inverse of national, natural forest area/non-forest area as the dependent variable as an indicator of deforestation. While forest area/total area has a range from 0 to 1, forest area/non-forest area can have values lower and higher than 1. Therefore, the latter satisfies the assumption of a random distribution of regression modeling residuals better than the former.

The forest data were updated by the FAO to the year 1995 (FAO 1999). We experimented also with the 2000 forest area data but they did not give as good outcomes as the 1995 data. Our conclusion was that 1995 data were more valid and reliable than the 2000 data. Additionally, the 1995 data provided the estimation of the reliability of data, which we used in weighting of the dependent variable. Our findings are not only dependent on the 1995 forest area data. We used the 2005 data (FAO 2006) with success in our modeling in Sect. 5.4.

The time dimension is inherently included in our data because the countries are at different development levels. The independent economic variables were

lagged by 5 years from their respective 1995 forest area data, in order to allow a cause-effect to mature. The ecological variables are assumed not to change over time.

The economic accessibility of both industrial and social plantation forests is usually less costly than that of natural forests. The increase of environmental plantation forests increases agricultural productivity and decreases pressure for clearing more forests for agriculture. Therefore, we assumed that expanding plantation forests would decrease deforestation of natural forests or a minus sign (forest-based development on the bottom right of Fig. 2.4).

Forest people were, and still are in many corners of the tropical world, income poor, but eventually consumption rich if the population densities are not too high in relation with the carrying capacity of the forest habitat. However, consumption per capita may not be a sufficient indicator of poverty (Angelsen and Wunder 2003). The World Bank (2001) has adopted opportunity, security, and empowerment to indicate poverty. This multidimensional indicator is not operational at the national level.

Therefore, we selected the inverse of the three-dimensional Human Development Index (HDI) (UNDP 2006) as our poverty indicator. The HDI is composed as a simple average of the indexes on life expectancy at birth, combined adult literacy, and school enrolment as well as local purchasing power parity of GDP per capita (UNDP 2003). The World Bank also adopted HDI to measure "opportunity." A poverty increase means a decrease in the HDI.

Natural forests provide the last resort for the poor (Angelsen and Wunder 2003). They have a low opportunity cost for their labor and can therefore increase their gathering of fuelwood and other items, hunting, and shifting cultivating in open access natural forests. These are all low capital cost activities for survival. Therefore, we assumed that the more poverty – the more deforestation (on the right of Fig. 2.4).

A simple two-variable Pearson correlation for 74 tropical countries between deforestation and poverty was computed (Fig. 5.11). The observations are distributed evenly over the whole range of the variables with no remarkable outliers. The distribution is therefore statistically quite operational.

Income (gross national product GNP) per land area-variable is assumed to indicate the overall environmental pressure (ecological footprint) of economic development, for instance, the clearing of forests for agricultural expansion, for urbanization, or for physical infrastructure, such as roads, reservoirs, hydroelectric power stations, etc. Therefore, we assume that increasing the GNP per land area causes a decrease of the forest area, which is indicated by a plus sign in our model specification. It is interesting to realize that GNP/land area can also be interpreted as an interaction variable as follows:

$$\text{GNP}/\cancel{\text{Population}} \times \cancel{\text{Population}}/\text{land area} = \text{GNP}/\text{land area}$$

Accordingly, GNP/land area indicates the joint interaction of income per capita and population density on deforestation (on the right of Fig. 2.4).

We assumed further that our study countries of mostly socialistic forestry (states own a majority of natural forests) exist with administrative stumpage pricing

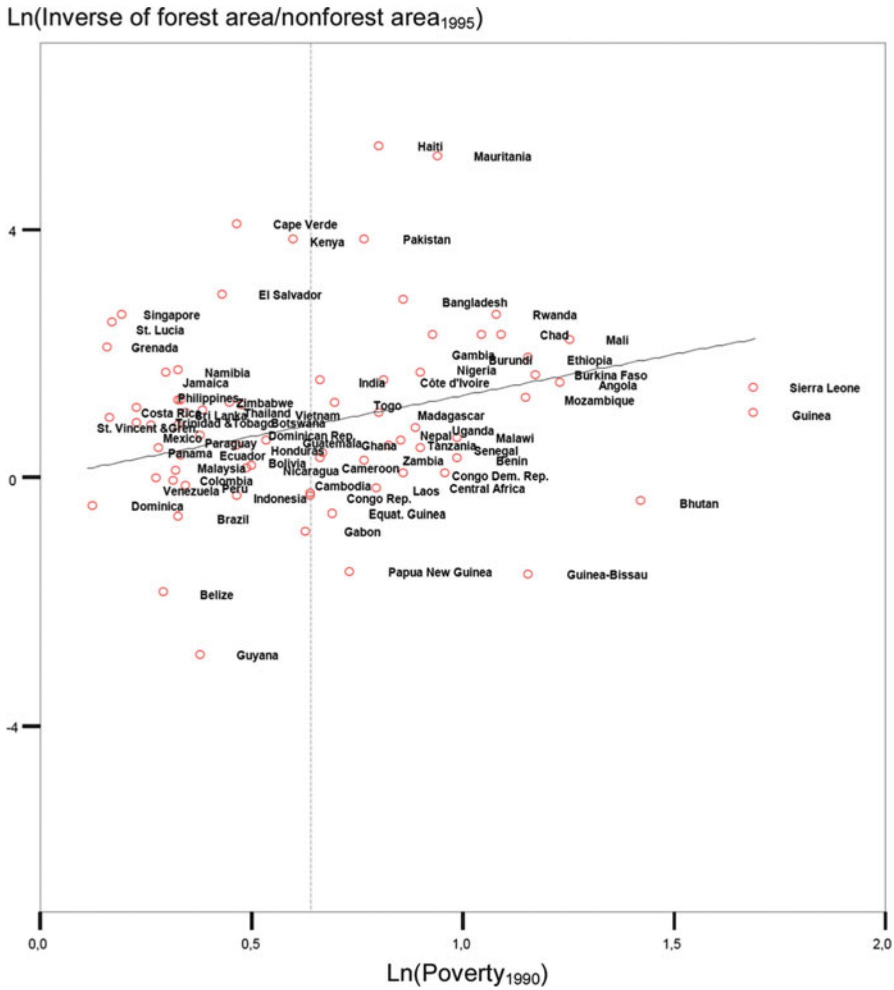


Fig. 5.11 Correlation between deforestation (inverted natural forest area/non-forest area) and poverty (inverted Human Development Index) in 74 tropical countries (weighted $r = 0.51$, non-weighted $r = 0.15$. The trend line is for non-weighted observations). The cut line divides the countries into poor and "less poor" groups of 37 countries (Data sources: FAO 1999; UNDP 2006)

(Sect. 5.1), where *de facto* open access to forests is prevailing. The expanding exports in forest, agricultural, mining, and other products increase the respective domestic demand, causing derived demand for deforestation or the clearing of forests.

For example, expanding exports of forest products will increase commercial logging and more logging roads will be constructed. After prevailing selective logging has been done, the concessionaire has no motivation to close the access from subsistence farmers. Hence, they will arrive and finalize the deforestation.

On the other hand, expanding agricultural exports increase domestic demand for agricultural products. Under conditions of extensification, this will expand forest clearing or deforestation for agriculture. Openness of trade is an indirect underlying cause of deforestation that is linked via multiple cause-effect chains.

Accordingly, an expanding openness of trade will indirectly decrease the forest area, because no scarcity effect will appear in the form of increasing real stumpage prices and real value of the remaining forest. Increasing imports may have a similar effect, because increasing imports imply increasing current account deficiencies. This again means increasing future exports in order to counterbalance these payments.

Therefore, we specified this openness of trade variable (at the top and center of Fig. 2.4) as the value of total exports plus the value of total imports divided by the value of the total GDP; a plus sign was assumed.

The impacts of agricultural technologies and productivity on deforestation have been examined by intensive micro-case studies with varying results (Angelsen and Kaimowitz 2001). We do not know of any similar studies at the macro level. The variable selected to measure agricultural productivity may have its own effect on the results. Here we applied the agricultural value added per hectare of agricultural land as the national variable to indicate agricultural productivity.

We assumed that most of our study countries were operating under the conditions of labor-intensive technology in a context with limited opportunities for in-migration, and an inelastic demand for agricultural products. Under these circumstances we assumed that an increase in agricultural productivity at the national level causes a decrease in deforestation or a negative sign.

Barbier et al. (2005) showed both theoretically and empirically that expanding corruption (on the left of Fig. 2.4) is increasing deforestation. Therefore, we assumed a plus sign.

Our complete deforestation model specification is represented by:

$$\mathrm{IF}_{it} = \mathrm{IF}\,(\underset{(-/+)}{\mathrm{ec}_i},\ \mathrm{wv}_{it},\ \underset{(-)}{\mathrm{PF}_{it-5}},\ \underset{(+)}{\mathrm{PO}_{it-5}},\ \underset{(+)}{\mathrm{GL}_{it-5}},\ \underset{(+)}{\mathrm{OT}_{it-5}},\ \underset{(-)}{\mathrm{AP}_{it-5}},\ \underset{(+)}{\mathrm{CO}_{it2}}) + \boldsymbol{\varepsilon}_{it} \qquad (5.1)$$

IF = inverse of national natural forest area,
i = number of the country,
t = year 1995,
ec = a vector for ecological variables (moist and dry areas),
wv = a vector for weight variables (forest area and forest data reliability),
PF = plantation forest area,
PO = poverty (inverse of Human Development Index),
GL = GNP per land area (GNP per capita times population density),
OT = openness of trade (value of total exports plus imports per GDP),
AP = agricultural productivity (agricultural value added per agricultural land area),
CO = corruption (inverse of Corruption Perceptions Index),
$t2$ = year 1998–2007,
ε = residual.

This Eq. 5.1 was applied for estimating the models in Tables 5.2, 5.3, and 5.4.

Table 5.2 Estimated multiple regression model of deforestation among the 37 "less poor" tropical countries (HDI ≥ 0.528)

	Dependent variable:	Inverse of forest area/nonforest area $_{1995}$				
	Independent variables	Coefficient	Std error	Std Coef.	*t*	Sig.
	Intercept	-4.630^{***}	1.359	0.0	−3.406	0.002
1	Moist ecological zone % of land area	-0.333^{***}	0.089	−0.464	−3.727	0.001
2	Dry ecological zone % of land area	0.493^{***}	0.095	0.758	5.203	0.000
3	Plantations area % of land area $_{1990}$	-0.814^{***}	0.252	−0.510	−3.231	0.003
4	Poverty (inverse of HDI) $_{1990}$	4.513^{***}	1.197	0.509	3.769	0.001
5	GNP/land area $_{1990}$	0.715^{***}	0.128	0.954	5.574	0.000
6	Trade % of GDP $_{1990}$	0.324^{**}	0.133	0.364	2.443	0.021
7	Agricultural productivity $_{1990}$	−0.177	0.164	−0.245	−1.084	0.288
8	Corruption (inverse of CPI $_{1998–2007}$)	1.008^{***}	0.276	0.508	3.658	0.001
Number of countries		37				
Adjusted R square		0.77				
Standard error of estimation		39.1				
F-statistic		15.7				
Significance of F-statistic		0.000				

Data sources: FAO (1999)/FORIS database; UNDP (1998, 2006), World Bank (1999), Transparency International (1998–2007)

Notes: ***Significance level under 1%, **Significance level under 5%

Log-Log WLS estimation. Cases weighted by value of variable forest area 1995 (ha) times reliability class of forest inventory (1 = High, 0.5 = Average, 0.25 = Low)

5.2.3 Model Estimation and Results

The multiple regression was run with weighted least squares (WLS) estimation and natural logarithmic variables. In weighting, we applied a ratio variable natural forest area divided by the reliability class of the forest inventory. In this way countries with larger forests and with higher reliability of forest inventory data received more weight in the estimation. This kind of weighting is our application, which we have not seen used before in deforestation modeling.

We selected this kind of modeling after we had done pilot study by modeling with the ordinary least squares (OLS) estimation method. The WLS estimation produced statistically a much better outcome than the OLS. We applied logarithmic transformations of the variables in order to fit better the assumed s-form function of deforestation and to be able to interpret the regression coefficients as elasticities of deforestation.

We made a pilot modeling of the relationship of forest and poverty (Palo 2004). Among 83 tropical countries the relative forest area increased along with an increase in income per capita. However, since forest areas are declining or deforestation is taking place in all of the countries studied, it is more rational to view this process from the opposite direction: at the national level increasing income poverty is reducing the forest area.

It is highly interesting that by replacing GDP per capita with the HDI in a model with population density as another independent variable the degree of determination

Table 5.3 Estimated multiple regression model of deforestation among the 37 poor tropical countries (HDI < 0.528)

	Dependent variable:	Inverse of forest area/nonforest area $_{1995}$				
	Independent variables	Coefficient	Std error	Std Coef.	*t*	Sig.
	Intercept	2.851	2.039	0.0	1.398	0.173
1	Moist ecological zone % of land area	–0.259*	0.139	–0.251	–1.868	0.072
2	Dry ecological zone % of land area	0.013	0.091	0.024	0.147	0.884
3	Plantations area % of land area $_{1990}$	0.158	0.361	0.111	0.438	0.665
4	Poverty (inverse of HDI) $_{1990}$	1.157*	0.610	0.261	1.895	0.068
5	GNP/land area $_{1990}$	0.401***	0.145	0.619	2.767	0.010
6	Trade % of GDP $_{1990}$	–0.404	0.314	–0.225	–1.290	0.208
7	Agricultural productivity $_{1990}$	–0.491***	0.134	–0.697	–3.675	0.001
8	Corruption (inverse of CPI $_{1998–2007}$)	0.288	0.376	0.081	0.767	0.450
Number of countries		37				
Adjusted R square		0.69				
Standard error of estimation		43.9				
F-statistic		11.0				
Significance of F-statistic		0.000				

Data sources: FAO (1999)/FORIS database, UNDP (1998, 2006), World Bank (1999), Transparency International (1998–2007)

Notes: ***Significance level under 1%, *Significance level under 10%

Log-Log WLS estimation. Cases weighted by value of variable forest area 1995 (ha) times reliability class of forest inventory (1 = High, 0.5 = Average, 0.25 = Low)

Table 5.4 Estimated multiple regression model of deforestation among 74 tropical countries (Palo and Lehto 2011)

	Dependent variable:	Inverse of forest area/nonforest area $_{1995}$				
	Independent variables	Coefficient	Std error	Std Coef.	*t*	Sig.
	Intercept	–2.714**	1.069	0.0	–2.538	0.014
1	Moist ecological zone % of land area	–0.245***	0.078	–0.257	–3.137	0.003
2	Dry ecological zone % of land area	0.297***	0.058	0.444	5.102	0.000
3	Plantations area % of land area $_{1990}$	–0.200	0.163	–0.114	–1.228	0.224
4	Poverty (inverse of HDI) $_{1990}$	2.133***	0.307	0.687	6.946	0.000
5	GNP/land area $_{1990}$	0.548***	0.083	0.808	6.588	0.000
6	Trade % of GDP $_{1990}$	0.314**	0.122	0.249	2.567	0.013
7	Agricultural productivity $_{1990}$	–0.278***	0.085	–0.339	–3.274	0.002
8	Corruption (inverse of CPI $_{1998–2007}$)	0.707***	0.234	0.275	3.017	0.004
Number of countries		74				
Adjusted R square		0.72				
Standard error of estimation		48.9				
F-statistic		24.6				
Significance of F-statistic		0.000				

Data sources: FAO (1999)/FORIS database, UNDP (1998, 2006), World Bank (1999), Transparency International (1998–2007)

Notes: ***Significance level under 1%, **Significance level under 5%

Log-Log WLS estimation. Cases weighted by value of variable forest area 1995 (ha) times reliability class of forest inventory (1 = High, 0.5 = Average, 0.25 = Low)

(the adjusted R square) was increased from 30% to 43%. Both regression coefficients were statistically significant at almost 0% risk (Palo and Lehto 2005).

A wider poverty concept, the "opportunity" or the Human Development Index had the effect of explaining the relationship between poverty and deforestation better than the income poverty concept. Also of special interest is that this model gives a pan-tropical explanation that includes empirical data from the three tropical continents.

Among the 74 tropical countries it was possible to have empirical data to indicate all eight variables as specified in our deforestation model (Eq. 5.1). In a previous study we have shown that we can reach quite similar results with this kind of model estimation by applying either the original inventory data or the updated 1995 data as we have done here (Palo et al. 2000).

UNDP (2006) divided countries into three classes according to the Human Development Index: low (HDI < 0.5), medium (HDI between 0.5 and 0.8), and high human development (HDI ≥ 0.8). Only 5 of the 74 tropical countries belonged to the high class.

We divided the 74 countries into two tiers of equal size: 37 countries with HDI ≥ 0.528 and 37 countries with HDI < 0.528 (Fig. 5.11). We first introduce the model estimation outcomes of the former tier (Table 5.2).

The regression coefficients received expected signs. Moist ecological zone, plantation forest density, and agricultural productivity had minus signs, although the last one was not statistically significant with a risk of 29%. In fact, only plantation forest density was decelerating the decrease of forest area, while the main role of the two ecological zone variables was to harmonize the ecological conditions among the 37 countries. The statistical significance at almost 0% risk and a minus sign of the plantation forest was highly interesting, because in the model of all the 74 countries the variable received no significance (Table 5.4).

The regression coefficients of the other four independent socio-economic variables were all statistically significant: the trade variable at 2% and the others at almost 0% risk. The following socio-economic variables had the highest standardized coefficients: GNP/land area, plantation forest density, poverty, and corruption. They were the strongest variables to explain the decline of the forest area. The role of corruption became stronger in this tier of the 37 less poor countries than in the model of 74 countries.

The model of Table 5.2 explained 77% of the variation of the relative forest area in this less poor tier of 37 countries in comparison with the respective explanation of 72% in the group of 74 countries (Table 5.4). The model of Table 5.3 covering 37 poor tropical countries explained 69% of the variation of the relative forest area. The estimation results of this model were not as good as from the model of the less poor countries. This is clear when we look at the significances of the coefficients below.

The estimation outcomes (Table 5.3) from the latter tier of 37 poor tropical countries (HDI < 0.528) are introduced next. Only four among the eight variables have statistically significant regression coefficients (under 7.3% risks): moist ecological zone, poverty, GNP/land area, and agricultural productivity. Here agricultural pro-

ductivity plays the strongest role in explaining the variation of the relative forest area as measured by the standardized coefficient and statistical significance.

It is interesting to observe the differences in modeling of the total group of 74 countries (Table 5.4) and the two sub-groups of the 37 countries (Tables 5.2 and 5.3). In the main group and in the first tier seven independent variables were statistically significant, and in the second tier only four were significant.

The primary regression coefficients can also be interpreted as elasticities of change. The elasticities of the latter model (Table 5.3) remain at a lower level than those of the former model (Table 5.2).

The quality of the regression models depends also on the multicollinearity of the independent variables. The highest absolute pairwise correlation in the model of the 37 less poor tropical countries (Table 5.2) was $r=-0.50$ between corruption and dry ecological zone. The high mutual correlations between agricultural productivity and some other variables played no role in this case due to the statistical insignificance of the former variable. Multicollinearity of this model was so low that it did not hamper its quality.

The highest absolute pairwise correlation in the model of the 37 poor tropical countries was $r=-0.61$ between agricultural productivity and poverty. The correlation between agricultural productivity and GNP/land area was $r=0.56$. All the other mutual absolute correlations were below $r=0.50$. This degree of multicollinearity most likely did not deteriorate the quality of the model (Table 5.3).

5.2.4 Discussion

Our deforestation modeling and the specification of the independent variables are based on the integration of the theories of new institutional economics, ecological economics, and property rights (Sect. 2.7; Fig. 2.4). Accordingly, the specification of our models rests on rational theoretical basis, which improves the quality of the estimation of the models.

The total number of tropical countries in modeling of deforestation was 74, which covered 94% of the total natural forests in the tropics. Thirty-five of the countries were from Africa, 24 from Latin America, and 15 from Asia. The inclusion of countries for modeling was determined by the availability of empirical data.

Lacking reliable time series of forest areas by country, we applied two ecological variables to control the varying ecological conditions of the 74 tropical countries. In this way we made the countries have a better fitting explanation for the socioeconomic variables. Accordingly, we have applied cross-sectional data, which have, however, a long implicit time dimension due to the great variety in the stage of development among the study countries.

The lower quality of forest area data for tier 2 of the poor countries may partially explain the inferior quality of the modeling outcomes (Table 5.3) in comparison with the less poor countries (Table 5.2).

Perhaps the most interesting finding in the tier of the less poor countries was that plantation forest density became significant, whereas in the total group it was not significant. Foresters commonly argue that the expansion of plantation forests will slow down deforestation of natural forests. In a group of better-off tropical countries this argument seems to be true but not overall, and particularly not among the poorest countries. Environmentalists, on the other hand, often argue that plantation forests are increasing deforestation. This can be true subnationally, when planting is done on sites of cleared natural forests.

In the total of 74 tropical countries agricultural productivity is decelerating deforestation (Table 5.4), and the same is taking place in the tier of the 37 poor tropical countries. In both cases there is almost 0% risk that the regression coefficients deviate from zero.

The message from our modeling of the role of poverty in relation to forests is rather clear. We can conclude that poverty and relative forest area at the national level are statistically strongly correlated. This may indicate a vicious circle as described by Dasgupta (1982).

In our parallel deforestation modeling (Palo and Lehto 2011) our policy implications concerned the natural forests of all the tropical countries. Here we are diversified at the national level to the poor and less poor tropical countries.

Poverty is a common cause of deforestation in the models of both tiers (Tables 5.2 and 5.3). However, a poor local individual cannot be responsible for deforestation, because his situation is determined by a number of underlying causes (Palo and Lehto 2011). Alleviating poverty would reduce deforestation in both tiers.

An increase in GNP per land area or "ecological footprint" is increasing deforestation in both the less poor and the poor countries (Tables 5.2 and 5.3).

In the less poor tropical countries increasing corruption is increasing deforestation. Reducing corruption would support both alleviation of poverty (Palo and Lehto 2011) and deforestation. The success on this front is not easy and in any case will require a long time (Sect. 5.1). The national elites are mostly benefiting from corruption. Therefore, the rich rather than the poor are more directly responsible for deforestation.

The more open the less poor tropical country is in foreign trade, the more deforestation is taking place. In Finland under clear and strong as well as mostly private property institutions the effect is vice versa (Sect. 4.6). In the tropics the remedy is the full pricing of all forest goods and services. Only then would the "invisible hand" raise the value of the remaining forest under a deforestation process and an automatic support for sustainable forestry would appear.

Increasing plantation forest density in the less poor countries seems to be an effective policy instrument in combating deforestation. The decelerating effect of plantations is of the same magnitude with the increasing effect on deforestation by corruption and poverty, when measured with the standardized regression coefficients. The Clean Development Mechanism (CDM) of the Kyoto Protocol and REDD+ provide examples of many financing options available for plantation investments (Sects. 5.1 and 5.3).

Increasing agricultural productivity is the only group-specific policy instrument according to our model (Table 5.3) among the poor tropical countries. This instrument

Photo 5.6 Our Metla/WIDER research team on a field tour in 1996 near to Balikpapan, Kalimantan, Indonesia. From the left: Birger Solberg, Norway, Matti Palo, Finland, Gerardo Mery, Chile, two local tour leaders, Olli Saastamoinen and Raija-Riitta Enroth, Finland, Roberto Scotti, Italy, Alexander "Sandy" Mather, Scotland, and Ari Siiriäinen, Finland. (Unfortunately Sandy and Ari passed away recently) (Photo: Erkki Lehto)

is also more effective than GNP/land area and poverty reduction. Agricultural production can be increased either by extensification or intensification. The former is applied by clearing forests as far as natural forests remain under-valued.

The application of intensification would mean increasing productivity, but it will not be mobilized until natural forests become valued by the markets, and not only for timber but also for other forest goods and services, such as carbon sequestration and biodiversity conservation. Transition to full market pricing of forests remains problematic under prevailing socialistic forestry and corruption (Sect. 5.1).

Our team (Photo 5.6) contributed in 1999 to "Forest Transition and Carbon Fluxes – Global Scenarios and Policies" (Palo 1999b). Our present findings provide an advanced basis to update our tropical carbon flux scenarios with further elaboration.

5.3 Underlying Causes of Expansion of Plantation Forests Among Tropical Countries

5.3.1 Introduction

The purpose of this section is to analyze the underlying causes of the expansion of tropical plantation forests at the national level among the tropical countries.

In 1992 the following statement was agreed on by the United Nations Conference on Environment and Development in Rio de Janeiro as point 6d of the "Forest

Photo 5.7 Seedlings are packed into plastic pots by local women in a nursery in 1990 on Mindanao island, the Philippines. This illustrates a kind of local employment created by plantation forests (Photo: Martti Saarilahti)

Principles": "The role of planted forests and permanent agricultural crops as sustainable and environmentally sound sources of renewable energy and industrial raw material should be recognized, enhanced and promoted. Their contribution to the maintenance of ecological processes, to offsetting pressure on primary/old-growth forests and to providing regional employment and development with the adequate involvement of local inhabitants should be recognized and enhanced" (United Nations 1992).

Plantation forests have been considered already for a long time as one instrument against tropical deforestation. They were expected to bring more cash income for rural people (Photo 5.7). Plantation forests were also assumed to fill a gap in supply of roundwood and to reduce imports of forest products. Furthermore, they were thought to improve degraded soils and watersheds (Nilsson-Axberg 1993; Varmola 2005; Carle and Holmgren 2008).

Contrary to these expectations, in our deforestation modeling of 74 tropical countries plantation forests did not appear a statistically significant underlying cause of decelerating deforestation in natural forests. Then we divided the sample into two equally large tiers by the level of poverty.

The poorest 37 tropical countries indicated the same outcome as above but among the less poor 37 tropical countries plantation forests were statistically significant in reducing deforestation of natural forests. This is a quite interesting novel finding: plantation forests do not decelerate deforestation pan-tropically but they do so among the richest 37 tropical countries (Sect. 5.2 above).

Plantation forests are not full substitutes for natural forests in the tropics. Trees are planted either on deforested sites or mostly in locations that are different from the deforested sites. Natural and plantation forests produce mostly different products and services (de Camino 1999). Plantation forests in tropical Southeast Asia are assessed to contain less than 50% of the carbon stock of the tropical natural forest (Lasco and Pulhin 2004).

Biological diversity is also much lower in plantation forests. The NGOs have especially been stressing this disadvantage of plantation forests along with their marginalization impact on local people (e.g., Lang 2007). Smallholder planted forest ownership has lately been increasing. In 2005 about a half of the planted forests were in private ownership (Del Lungo et al. 2006). This tenure may have supported the expansion of planted forests also in the tropics.

Plantations can fully replace fuelwood from natural forests but only partly the multiplicity of industrial wood supply and non-wood products. Plantation forests are primarily monocultures (Photo 5.8). Their wood production capacities per hectare can be as high as 30–70 m^3/ha/a with rotations of 5–20 years in Brazil (Tomberlin and Buongiorno 2001).

Financial profitability (internal rate of return) of Acacia plantations for a private investor in a case study in the Philippines varied between 8% and 15% according to the steepness of the slopes (Niskanen 2000) but in Eucalyptus plantations in Brazil (Photo 5.9) as high as 15–29% (Sedjo 1983). We may assume that this high profitability has supported Brazil as a major location for industrial plantation forests along with the various additional tax holidays and subsidies available.

The evolution of tropical plantation forests has been frequently analyzed from the point of view of timber supply (Hakkila 1994; Tomberlin and Buongiorno 2001; Canavera 2001). Mather (2000) wrote about a paradigm of plantation forests counting both pros and cons of their expansion. Plantations may reduce pressure from deforestation but they often bring a colonial flavor by neglecting the local interests.

In the 1990 tropical forest assessment natural forests and their deforestation were reported separately from plantation forests (FAO 1993b), while in the later 2000, 2005, and 2010 assessments a "net deforestation" concept, natural forest deforestation plus plantation forest expansion, was unfortunately adopted (FAO 2001b, 2006, 2010a). We made our own computation on the expansion of plantation forests in 92 tropical countries during 1990–2005 (Table 5.5).

We assume that although the same underlying causes may be effective in changes of natural forests and plantation forests, the processes most likely are different.

A special global survey of planted forests (plantation forests plus semi-natural forests) in 2005 was implemented by FAO (Del Lungo et al. 2006). It analyzed the consequences of the expansion of planted forests. No evaluation of the validity and reliability of these data were made, although a common knowledge tells us that the quality of plantation forest data is dubious (Hakkila 1994; Tomberlin and Buongiorno 2001; Marzoli 2001) due to the problem of survival of the plantations and other

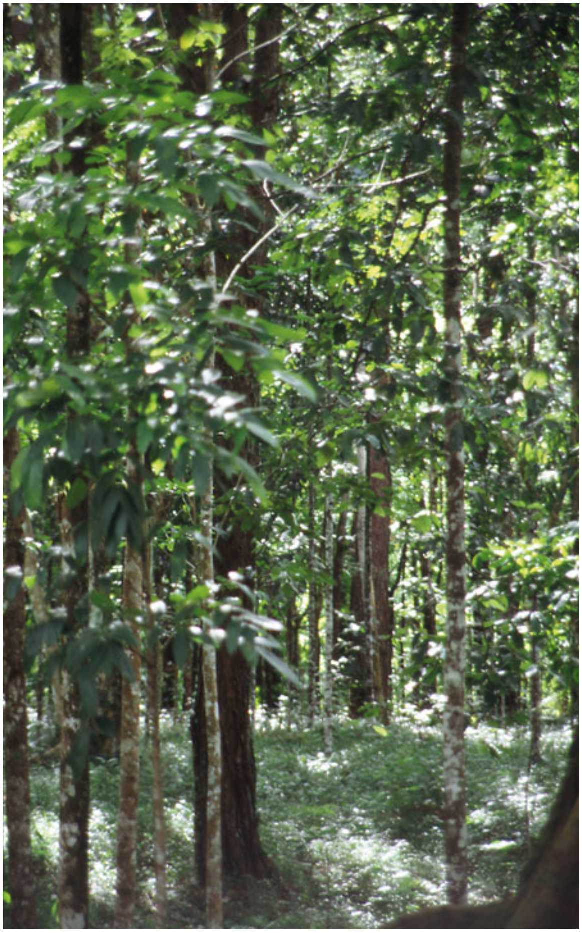


Photo 5.8 A plantation forest of mahogany in 1990 on Mindanao Island, the Philippines (Photo: Martti Saarilahti)

complicating factors. Neither the 2005 survey nor the other references here analyzed the causes of the expansion of planted forests.

We aim to fulfill this gap of knowledge by studying the underlying causes of the expansion of plantation forests in the tropics.

Brazil, Sudan, Indonesia, and Thailand have largest plantation forests established for industrial purposes in the tropics. The total area of industrial plantation forests in the tropics was 15.5 million hectares in 2005. The area increased 1.1 times between 1990 and 2005. The largest increases took place in Vietnam and Indonesia (Del Lungo et al. 2006). Especially Malaysia and Indonesia have large rubber tree plantations (Photo 5.10), which FAO has lately included into plantation forests.

Plantation forests have, however, also been established for social and environment protection purposes, especially in India, Thailand, Mexico, Vietnam, and Sudan.

Photo 5.9 A six-year-old plantation forest of eucalyptus in 1991, Esperito Santo, Brazil (Photo: Jari Parviainen)

Table 5.5 Expansion of plantation forests and deforestation of natural forests in 92 tropical countries during 1990–2005 (cf. Table 5.13)

	Latin America			Africa			Asia		
	1990	2000	2005	1990	2000	2005	1990	2000	2005
Natural forest area (million ha)	935	889	865	672	628	607	341	311	295
Plantation forest area (million ha)	6	8	8	9	9	9	13	15	17
Total forest area (million ha)	941	897	873	681	637	616	354	327	312
Deforestation of natural forest (million ha/year)		4.7	4.7		4.5	4.1		3.0	3.3
Reforestation (million ha/year)		0.2	0.1		0.0	0.0		0.2	0.3
Deforestation of total forest (million ha/year)		4.5	4.7		4.5	4.1		2.7	3.0

Data source: FAO (2006)

The total protective plantation forest area of these five countries was 5.8 million ha in 2005. The area increased 1.9 times during 1990–2005 (Del Lungo et al. 2006).

The total plantation forest area in the tropics was 35 million ha in 2005. The area increased 1.2 times during 1990–2005 (Table 5.5).

Photo 5.10 A plantation forest of rubber trees in Kalimantan, Indonesia (Photo: Erkki Lehto)

The plantation forests in the tropical countries tend to be concentrated in a number of rather few major countries, while the ecological conditions would favor their establishment in a much higher number of countries. We may assume that the socio-economic conditions of most tropical countries have prevented the wide expansion of plantation forests.

5.3.2 Theory, Method, and Data

Both ecological and socio-economic factors were thought to be the underlying causes of expansion of plantation forests. We excluded the direct local actors (relative prices, laws, taxes, subsidies) from our plantation modeling in accordance with our deforestation modeling.

We conceptualized the expansion of plantation forests within the theories of institutional economics and ecological economics and under the universal system causality model describing the change in forest resources (Sect. 2.7). According to this forest transition model the same causes are decreasing forests (deforestation) and increasing forests (reforestation by expansion of plantation forests). In the former case we view forest transition ex-ante and in the latter case ex-post.

In our modeling we applied multiple variable regression analysis with weighted least squares (WLS) estimation. As weights we applied national plantation forest areas divided by data reliability and sole plantation forest areas. In this way coun-

tries with larger plantation forest areas received more weight than the smaller ones and more reliable data more weight than less reliable data.

We used the plantation forest, natural forest, and land area data for 1995 of FORIS database (FAO 1999). Plantation forests in the tropics refer to monocultures of exotic tree species, mostly Eucalyptus sp., tropical pines, teaks, acacias, Gmelina, etc., which often form rectangular stands of trees of uniform size and geometric spacing. The other data used were from the sources indicated in the footnote of the model (Table 5.6). We included 71 tropical countries in our sample or all those tropical countries that were able to provide relevant data.

The signs of the independent variables were assumed in a separate procedure for the plantation model from the deforestation model. Decreasing natural forests are expected to induce in expansion of plantation forests according to the popular belief (United Nations 1992; Varmola 2005). On the other hand, expansion of plantation forests would benefit from large-scale natural forests because they would provide many opportunities of clearing for plantation sites. These contrasting views leave the sign unspecified.

Social plantation forests are established in many countries in order to produce fuelwood for the local poor. High poverty reflects also low opportunity costs for labor, which facilitates low-cost planting work. Planting is a labor-intensive activity. We specified a plus sign for the poverty variable.

When GNP/land area is increasing environmental deterioration is taking place. This is inducing more plantation forests for environment protection. On the other hand, higher GNP facilitates more funding for establishing more plantation forests. Therefore, we specified a plus sign for GNP/land area.

Openness of trade was assumed to reflect more business motivation for industrial plantation forests along with expanded financing options. We specified a plus sign.

Increasing agricultural productivity releases sites of poor productivity for expansion of plantation forests. Increasing productivity also indicates expanding financing options. Accordingly a plus sign was specified.

In investing in plantation forests not only profitability but also uncertainty and risk should be considered according to the portfolio theory. Political country risk originates from corruption and consequent unstable governance. Therefore we specified a minus sign for the corruption variable.

We specified our model in the following way:

$$PF_{it} = PF\,(\underset{(+/-)}{ec_i},\ wv_{it},\ \underset{(+/-)}{NF_{it-5}},\ \underset{(+)}{PO_{it-5}},\ \underset{(+)}{GL_{it-5}},\ \underset{(+)}{OT_{it-5}},\ \underset{(+)}{AP_{it-5}},\ \underset{(-)}{CO_{it2}}) + \boldsymbol{\varepsilon}_{it} \tag{5.2}$$

PF = plantation forest area,
i = number of the country,
t = year 1995,
ec = a vector for ecological variables (moist and dry areas),
wv = a vector for weight variables (plantations area and forest data reliability),
NF = natural forest area,
PO = poverty (inverse of Human Development Index),
GL = GNP per land area (GNP per capita times population density),

OT = openness of trade (value of total exports plus imports per GDP),
AP = agricultural productivity (agricultural value added per agricultural land area),
CO = corruption (inverse of Corruption Perceptions Index),
$t2$ = year 1998–2007,
ε = residual.

This Eq. 5.2 was specified for estimating the model in Table 5.6.

5.3.3 Model Estimation

Plantation forest area as a percentage of total land area was the dependent variable.

The model of plantation forests with plantation forest/reliability as a weight was estimated with interesting outcomes (Table 5.6). Two ecological variables, moist and dry ecological zones, were both statistically highly significant. They harmonized the ecological variation among the 71 sample countries in order to produce less biased coefficients for the socio-economic variables.

The relative natural forest cover increased relative plantation forest with almost zero risk of the regression coefficient. When the inverted HDI as an indicator of poverty increased, the relative plantation forest expanded with almost zero risk.

Table 5.6 Estimated multiple regression model of plantation forests in 71 tropical countries

	Dependent variable:	Plantations area (% of land area) $_{1995}$				
	Independent variables	Coefficient	Std error	Std Coef.	t	Sig.
	Intercept	−4.851***	0.992		−4.891	0.000
1	Moist ecological zone % of land area	−0.181***	0.068	−0.188	−2.679	0.009
2	Dry ecological zone % of land area	0.248***	0.056	0.636	4.428	0.000
3	Natural forest area/nonforest area $_{1990}$	0.394***	0.111	0.668	3.554	0.001
4	Poverty (inverse of HDI) $_{1990}$	1.995***	0.467	0.554	4.273	0.000
5	GNP/land area $_{1990}$	0.631***	0.151	0.655	4.195	0.000
6	Trade % of GDP $_{1990}$	0.158	0.098	0.142	1.611	0.112
7	Agricultural productivity $_{1990}$	0.167	0.128	0.168	1.300	0.198
8	Corruption (inverse of CPI $_{1998–2007}$)	0.492**	0.199	0.224	2.475	0.016
Number of countries		71				
Adjusted R square		0.77				
Standard error of estimation		4.94				
F-statistic		29.5				
Significance of F-statistic		0.000				

Data sources: FAO (1999)/FORIS database, UNDP (1998, 2006); World Bank (1999), Transparency International (1998–2007)

Notes: ***Significance level under 1%, **Significance level under 5%

Log-Log WLS estimation. Cases weighted by plantations area 1995 (ha) times reliability class of forest inventory (1 = High, 0.5 = Average, 0.25 = Low)

Table 5.7 The Pearson correlation matrix for the plantation model of Table 5.6

		Plantations area %	Moist area	Dry area	Nat.forest area	Poverty	GNP/ land	Trade % of GDP	Agricult. prod.
1	Moist area %	–0.320	1.000						
2	Dry area %	0.476	0.006	1.000					
3	Nat. forest area	–0.603	0.200	–0.758	1.000				
4	Poverty	0.473	–0.206	0.520	–0.765	1.000			
5	GNP/land area	0.707	–0.126	0.399	–0.523	0.084	1.000		
6	Trade % of GDP	–0.249	–0.071	–0.650	0.354	–0.284	–0.278	1.000	
7	Agricult. prod.	0.586	–0.326	–0.137	–0.133	–0.044	0.687	0.167	1.000
8	Corruption	0.196	–0.037	–0.389	–0.057	0.236	0.005	0.377	0.373

GNP/land area or “ecological footprint” also increased plantation forests with almost zero risk.

Increasing corruption expanded plantation forests with a coefficient of 1.6% risk. Increasing openness of trade expanded plantation forests with an 11.2% risk. The risk was only 4.7% when the weighting variable was only plantation forest area (excluding reliability). Agricultural productivity did not become statistically significant in either of the two types of weighting.

The model of Table 5.6 explained 77% of the variation of the relative plantation forest area at the national level in the 71 tropical countries. Multicollinearity (Table 5.7) was acceptable with perhaps two exceptions: the pairwise correlation between natural forest area and poverty was $r=-0.765$ and between natural forest area and dry ecological zone area $r=-0.758$.

Last we shall discuss our approach and findings.

5.3.4 Discussion

The plantation forest model (Table 5.6) is compared with the natural forest model (Table 5.4).

In the natural forest model we found that plantation forests were not statistically significant on deforestation among the 74 tropical countries. However, the plus sign of the relative natural forest area in our plantation model seems to support the view that plantation forest area is higher when natural forest area is higher. We may assume that large-scale natural forests have supported more forestry know-how than small-scale natural forests. This may have promoted the establishment of plantation forests. The sign and significance of the natural forest area is, however, unsure because of the observed multicollinearity.

Agricultural productivity was not statistically significant in the plantation model but increasing productivity was significantly decelerating deforestation of natural forests according to the deforestation model.

Increasing corruption was decreasing natural forest area but expanding plantation forests against our specification. The latter finding was a surprise and against the

portfolio theory (simultaneous evaluation of profitability and risk) but could be understood e.g., that with increasing corruption, state subsidies to support expanding plantations are increased and used as a kind of “legal” financial flow of corruption money to the elite land owners. In Brazil companies could invest up to 50% of their income taxes in tree planting since 1966 (Parviainen 1988). This may have induced corruption.

The ranking of the independent variables according to the standardized coefficients was as follows: relative natural forest area, GNP/land area, poverty, corruption and openness of trade. This ranking can be interpreted to imply the strength of their causal impact on increasing plantation forest area. The two ecological variables were excluded from this ranking.

The global convention on biological diversity and other similar intergovernmental and national agreements and laws (Sect. 5.7) will suppress the future roundwood supply from natural and semi-natural tropical, subtropical, temperate, and boreal forests. This trend along with the globalization of the forest industries will speed up the expansion of tropical plantation forests (Carle and Holmgren 2008). This will happen also due to their high financial profitability (Sedjo 1983; Mather 2000; Niskanen 2000).

There already exist also new management systems for plantation forests toward “ecosystem-based multiple use forestry.” This is based on careful planning of future plantation area for various zones with one primary and some secondary functions according to ecological and socio-economic contexts. Timber, water, habitat diversity, visual quality, non-forest and special functions provide examples of primary functions of such zones by Westvaco Company in South Carolina in the United States (Canavera 2001).

Another simpler plantation forestry management system is applied in New Zealand. It had 1.6 million hectares of plantation forests (6% of land area) in 2000, primarily of *Pinus radiata* from California. They were privatized and their primary function was defined as commercial logging. The natural forests of 6.5 million hectares (24% of land area) have been mainly (3/4) in state ownership. In 1985 they were transformed as protection forests for ecosystem management excluding logging. Also the privately owned minority of natural forests could be used for commercial logging only under strict sustainability criteria (Maclaren 2001).

The two cases above come from non-tropical countries. In the tropical countries, e.g., in Brazil, there may exist some environmental requirements for the planting companies. The site of tree planting may be identified according to national or subnational land use plan, which mostly excludes the best farming land. A certain amount of natural forests protection can be required to accompany the expansion of plantation forests. (This paragraph is based on comments by Jussi Saramäki and Martti Varmola.)

“Planted forests also impact the provision of ecosystem services, so planning, management, and utilization and monitoring mechanisms should be adopted to maintain and enhance the conservation of environmental services by adopting watershed management, soil erosion protection and landscape approaches to maintain water, soil, forest health, nutrient and carbon balances and restore degraded landscapes.”

"Furthermore, an indirect benefit of planted forests, if planned and managed responsibly, is to take some pressure for wood for industrial purposes away from native forests to allow them to be managed for conservation, protection and recreation purposes" (p. 16 in Carle and Holmgren 2008).

5.4 Causes and Scenarios of Deforestation in Mexico

5.4.1 Introduction

The first purpose of this section is to determine the underlying causes of deforestation in Mexico. The second is to find out the underlying causes of deforestation in the tropics in general and to compare them with Mexico's results under the same model specification. The third purpose is to create a few scenarios on deforestation in Mexico.

Why was Mexico chosen as a case study country in this book? Mexico and Papua New Guinea were traditionally the only countries in the world where community forests are the prevailing form of forest ownership. Lately, however, due to devolution activities five more countries have appeared in this category: Colombia, Ecuador, Kenya, Lesotho, and Sierra Leone (FAO 2010a).

Mexico had relevant empirical data available by 32 states, while Papua New Guinea did not have such data. We had already studied Finland with private forestry prevailing (Chaps. 3 and 4). Above (Sects. 5.1 and 5.2) we have analyzed deforestation in the tropical countries with public forests prevailing. By making a deforestation study of Mexico, we shall have a comparison on sustainability implications by community, private, and public forest ownerships.

Ancient indigenous peoples were living in forests in many parts of Central and South American tropics. They totaled 30 million before 1492. The lime-rich soils of the Yucatán Peninsula provided one such habitat. Dense population and flourishing civilizations were built up centuries before the arrival of the Spanish conquistadors. The dense population and the high level of culture surprised the European invaders (Harcourt and Sayer 1996).

The United Mexican States (Mexico) of is composed of 32 individual states with a wide variety of cultures, natural resources, and landscapes. Mexico is, after Brazil and Argentina, the third largest country in Latin America. Its land area covers 1.9 million km^2, of which 33% is covered by forests (Table 5.8; Map 5.2). Mexico is highly mountainous but has also wide flat zones. The wide scale and complex topography and climate make Mexico one of the ecologically most diverse countries in the world (Harcourt and Sayer 1996).

The most northern tropical forests in the Americas are found in Mexico, which lies mostly south of the Tropic of Cancer. In this zone not only rain forests but also seasonal forests, montane, and mangrove (only little) forests exist. Pine and oak forests are typical in the medium and high elevations (>1,500 m). As many as 70

Table 5.8 Forestry statistics of Mexico

	FAO 2006	FAO 2010
Total forest area (million ha)	64	65
Total forest share of land area (%)	34	33
Plantation forest area (million ha)	1.1	3.2
Deforestation of total forest (million ha/year)	0.3	0.2

70% temperate forests and 30% tropical forests
1,130 tree species and 70 different pine species
Data sources: FAO (2006, 2010a)

Map 5.2 Vegetation map of Mexico (*Source*: INEGI 2010)

different pine species have been identified (Photo 5.11). Contemporary forest area covers about a half of the original forest area (Map 5.2).

A few big farmers, *latifundios*, owned most of the forest until the Revolution of 1910. Until the 1930s, 80% of the forests were allocated to common forests of *ejidos* and *comunidades*, to be used by former peasants (Photo 5.12), landless rural workers, and communities of indigenous people. The rest of the forests were divided between private owners (15%) and the state (5%) (Antinori and Rausser 2001; Arnold 1998).

The *ejidos* were located on private lands, while the *comunidades* lied on the state lands with usufructs. These forests were managed and used under strict control of the government until the 1980s. Then with the renewed forest law more power was delegated to these local commons (Mery et al. 2001).

Photo 5.11 Pine forests and deforested mountains in Mexico (Photo: Klaus von Gadow)

Photo 5.12 Herding cattle in pine forests is a traditional way of multiple use forestry in Mexico (Photo: Klaus von Gadow)

Photo 5.13 Mangrove trees and deforested mountains in Baja California, Mexico (Photo: FAO/Christel Palmberg-Lerche)

Photo 5.14 Soil erosion after deforestation in Mexico (Photo: FAO/Christel Palmberg-Lerche)

The 1992 law allowed agricultural land to become privatized with a unanimous decision of the partners of the common forest, but forests remained as common property (Antinori and Rausser 2001).

Forest degradation and deforestation have been serious problems during the last three decades in Mexico (Photos 5.13 and 5.14). Estimates of annually deforested areas have varied from 0.6 to 1.5 million ha (Harcourt and Sayer 1996). The FAO

estimate was 0.3 million ha of total forest for 1990–2000 and 2000–2005 (FAO 2006). Later FAO (2010a) assessed almost the same estimates for 1990–2005 and lowered the latest estimate to 0.2 million ha for 2005–2010. Estimates of annual deforestation of natural forest (excluding plantations) were higher: 0.5 million ha for 1990–2005 and 0.3 million ha for 2005–2010.

It is interesting to apply the same specification of deforestation model first to Mexico and then at the pan-tropical level. If the mix of the visible local agents (proximate causes) in clearing of forests varies by continents, countries, and sub-national areas, the underlying causes are assumed global (Sect. 5.2). Another specific interest here is that the global tropical model exhibits countries, where the public forests are prevailing, while community forest ownership dominates in Mexico.

We found only a few studies focusing on the causes of deforestation covering the whole of Mexico (e.g., Deininger and Minten 1999). An assumption was made that the factors determining increases in the land under agricultural production and pasture would also be the underlying causes of deforestation. This assumption is not necessarily true in Mexico. This early study of deforestation in Mexico found prices of maize, fertilizers, and beef as well as credit disbursement to influence agricultural expansion. Also human population and income per capita were positively correlated with cattle expansion (Barbier and Burgess 1996).

The 32 individual states of Mexico were numerous enough to give a sufficient number of degrees of freedom for multiple regression modeling. Mexico also has large forests and has had large deforestation rates until recently. In 1999 Matti Palo, a co-author of this section, had the chance to familiarize himself during a fact-finding tour in the state of Chihuahua and in Mexico City.

5.4.2 Model Specification

The specification of the models was based on the same institutional economics and ecological economics frame model (Sects. 2.7 and 5.2). Equation 5.3 specifies the dependent and independent variables with their expected signs:

$$\mathrm{IF}_{it} = \mathrm{IF}\,(\underset{(-/+)}{\mathrm{ec}_i},\ \mathrm{wv}_{it},\ \underset{(-)}{\mathrm{HD}_{it-10}},\ \underset{(+)}{\mathrm{GL}_{it-15}},\ \underset{(-)}{\mathrm{AP}_{it-15}},\ \underset{(+)}{\mathrm{CO}_{it2}}) + \boldsymbol{\varepsilon}_{it} \tag{5.3}$$

IF = inverse of natural forest area,
i = number of the country (or subnational unit),
t = year of forest area data (2005 or 1993),
ec = a vector for ecological variables (moist and dry areas),
wv = a vector for weight variables (forest area and forest data reliability),
HD = Human Development Index (or GDP per capita),
GL = GNP (or GDP) per land area (or population density),
AP = agricultural productivity (agricultural value added per agricultural land area),
CO = corruption (inverse of Corruption Perceptions Index),

$t2$ = year 1998–2006,
ε = residual.

This Eq. 5.3 was applied for estimating the models in Tables 5.9 and 5.10.

The forest and land area, ecological zone, and population data by states in Mexico were based on the 1999 FORIS database of FAO. State-wise data from Mexico was not available later on from FAO. The source for GDP and agricultural data was INEGI (2002).

We applied three statistically significant ecological variables to control the varying ecological conditions among the individual states. In this way it was possible to reduce biases in the coefficients of the socio-economic variables. Increasing population density was assumed to decrease forest area at the Mexican level of income.

Corruption Perceptions Index (CPI) and Human Development Index (HDI) are available only at the national level. Therefore, we could not apply them at the state level. However, GDP/capita replaced HDI as a poverty measure. We assumed that the more poverty or lower income the less forest.

Increasing GDP/land area or ecological footprint was assumed to decrease forest area. On the other hand, increasing agricultural productivity was anticipated to slow down deforestation.

In this section pan-tropical modeling was done with the 2005 forest area data (FAO 2006). In Sect. 5.2 the 1999 database of FAO was applied. Therefore, we shall here achieve also a comparison at the pan-tropical level of the two data sets.

5.4.3 Model Estimation

We estimated four deforestation regression models for Mexico (Table 5.9). Models 1–2 were estimated with the standard ordinary least squares (OLS) method, while models 3–4 were estimated with weighted least squares (WLS) method using forest areas as weights. Except for the estimation method, models 3–4 are the same as models 1–2.

Models 1 and 3 have GDP/land area as an independent variable, while in models 2 and 4 GDP/land area was replaced by population density. Both variables could not be included in the same model because of high correlation between the two ($r=0.95$). This is the only difference between the explanatory variables of the models.

Interesting outcomes from the four models appeared with expected signs and statistically significant coefficients. Population density, GDP/land area, and GDP/capita had the highest standardized coefficients. Perhaps models 3–4 are superior to models 1–2 due to weaker multicollinearity and WLS estimation method. The models explain 67–71% of the variation of the subnational relative forest area.

Multicollinearity in the models is acceptable. The highest absolute pairwise correlation is $r=0.73$ for model 1, $r=0.79$ for model 2, and $r=0.59$ for models 3–4. GDP/capita and GDP/land area have only low mutual correlations of $r=0.36$ for model 2 and $r=-0.03$ for model 4. The distributions of the model residuals are also rather random, which supports the acceptable quality of the four models.

Table 5.9 Estimated multiple regression models of deforestation among 30 states of Mexico

		Model 1	Model 2	Model 3	Model 4
	Dependent variable:	Inverse of forest area/nonforest area $_{1993}$			
	Independent variables	Coefficient (Standard error in parenthesis)			
	Intercept	8.74***(2.82)	11.5***(2.92)	5.57[a] (4.17)	9.03* (4.52)
1	Desertic ecological zone % of land area	0.84***(0.15)	0.83***(0.15)	0.82***(0.17)	0.82***(0.19)
2	Premontane moist ecological zone % of land area	–0.37***(0.08)	–0.37***(0.08)	–0.36***(0.07)	–0.39***(0.08)
3	Montane dry ecological zone % of land area	0.73** (0.30)	0.75** (0.30)	0.57***(0.14)	0.56***(0.15)
4	Population density $_{1990}$	0.79***(0.17)	[x]	0.81***(0.14)	[x]
5	GDP/capita $_{1993}$	–0.69** (0.34)	–1.42***(0.35)	–0.56** (0.23)	–1.38***(0.27)
6	GDP/land area $_{1993}$	[x]	0.79***(0.18)	[x]	0.82***(0.16)
7	Agricultural productivity $_{1993}$	–0.50** (0.20)	–0.46** (0.19)	–0.28* (0.15)	–0.25[a] (0.16)
Weight variable		–	–	Forest area$_{1993}$	Forest area$_{1993}$
Adjusted R square		0.68	0.68	0.71	0.67
Standard error of estimation		0.61	0.61	18.2	19.6
F-statistic		11.2	11.0	13.0	10.6
Significance of F-statistic		0.00	0.00	0.00	0.00

Data sources: FAO (1999)/FORIS database, INEGI (2002)

Notes: ***Significance level under 1%, **Significance level under 5%, *Significance level under 10%, [a]Significance level under 15%, [x]variable excluded due to multicollinearity. Log-Log OLS or WLS estimation. 2 outliers excluded (Coahuila, Sonora)

Table 5.10 Estimated multiple regression model of deforestation among 64 tropical countries with 2005 forest area data (FAO 2006)

	Dependent variable:	Inverse of forest area/nonforest area $_{2005}$				
	Independent variables	Coefficient	Std error	Std Coef.	*t*	Sig.
	Intercept	1.806***	0.608	0.0	2.968	0.004
1	Moist ecological zone % of land area	−0.257***	0.073	−0.293	−3.532	0.001
2	Dry ecological zone % of land area	0.229***	0.061	0.400	3.749	0.000
3	Human Development Index $_{1995}$	−3.901***	0.818	−0.653	−4.771	0.000
4	GNP/land area $_{1990}$	0.338***	0.105	0.544	3.214	0.002
5	Agricultural productivity $_{1990}$	−0.143	0.102	−0.188	−1.400	0.167
6	Corruption (inverse of CPI $_{1998–2006}$)	0.582**	0.233	0.241	2.502	0.015
Number of countries		64				
Adjusted R square		0.63				
Standard error of estimation		51.7				
F-statistic		18.9				
Significance of F-statistic		0.000				

Data sources: FAO (2006, 1999)/FORIS database, UNDP (1998), World Bank (1999), Transparency International (1998–2007)

Notes: ***Significance level under 1%, **Significance level under 5%

Log-Log WLS estimation. Cases weighted by forest area 1995 (ha) times reliability class of forest inventory (1 = High, 0.5 = Average, 0.25 = Low)

The pan-tropical model of deforestation was estimated with available data from 64 countries of Africa, Asia and Latin America (Table 5.10). Our estimation with the WLS method gave expected signs and statistically significant coefficients with the exception of agricultural productivity, which had a risk of 17%.

These outcomes of Tables 5.9 and 5.10 support the idea that global modeling by countries and national modeling by sub-national units bring similar findings. Our previous studies also brought similar findings in 477 tropical sub-national units (Uusivuori et al. 2002) and in 171 Latin American sub-national units (Palo et al. 1996). All the socio-economic variables of the Mexican models were statistically significant also at the pan-tropical level. Our conclusion is that the same theory frame and method are valid in both national and sub-national modeling cases.

5.4.4 Deforestation Scenarios for Mexico

We also made scenarios on the decline of natural forest area in Mexico (Fig. 5.12). These scenarios were estimated in 1999, when the national forest area was assessed at a lower level from the present one. This was partly due to a renewal of forest concept (FAO 2006), which allowed smaller tracts of forest and shorter trees to be counted.

Therefore, the shapes of the scenarios are more relevant than the absolute levels. The amount of plantation forest was assessed as 1.1 million ha in 2000 and 2005

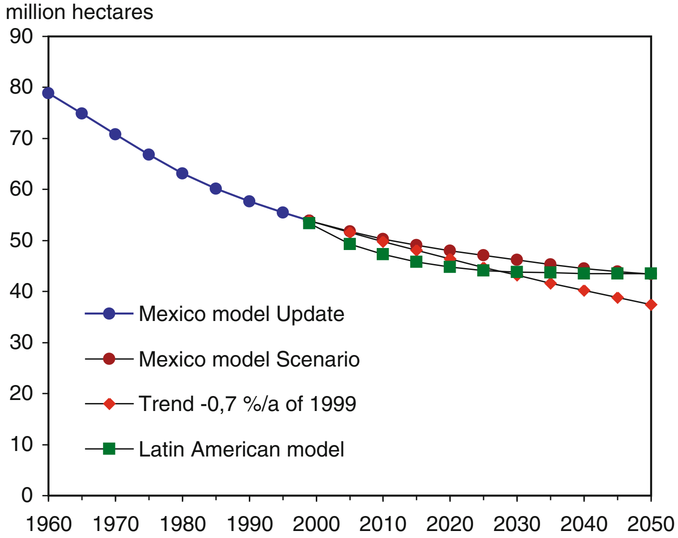


Fig. 5.12 Natural forest area in Mexico 1960–2050 (Data sources: FAO 1999; United Nations 1998; World Bank 1999)

(FAO 2006). Later FAO (2010a) revised the 2005 estimate up to 2.4 million hectares and assessed the latest estimate to 3.2 million ha for 2010.

We made three scenarios with different models (Fig. 5.12). We first applied a non-linear trend estimation for scenarios until 2050 based on the relative deforestation rate of 1999.

Next we applied a deforestation model for Mexico with ecological variables and population density to assess forest area observations backwards until 1960 in the absence of any reliable time series of forest inventories. Then we used the same model with the medium population growth scenario of the United Nations (1998) (Fig. 5.13) to compute scenarios until 2050.

Our third forest area scenario was based on our Latin American deforestation model (Palo et al. 1996). In this scenario we assumed a 2%/year growth rate for GNP (World Bank 1999) and the medium population growth scenario for Mexico.

5.4.5 Discussion

An interesting outcome here was that the forest data for 64 tropical countries were based on the 2005 assessment (FAO 2006), while most of our previous studies (Sect. 5.2; Palo and Lehto 2005, 2011) were based on the 1995 forest data (FAO 1999). Our 2011 study incorporated six independent socio-economic variables and here only four. In the latter case agricultural productivity and openness of trade did not become statistically significant as they appeared in our 2011 study. Our deduction

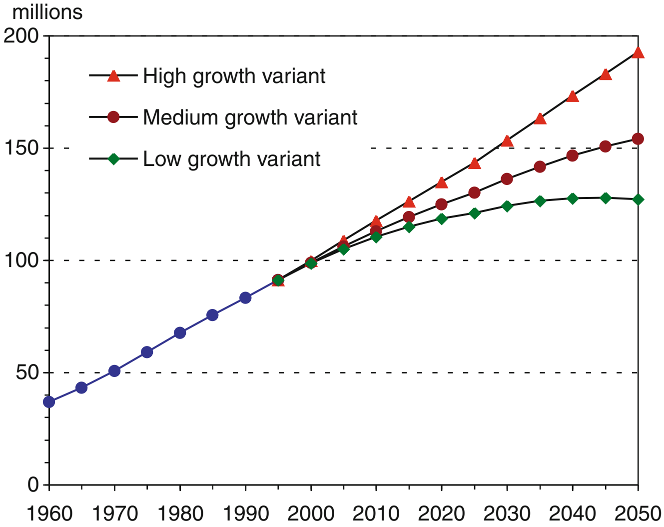


Fig. 5.13 Total population in Mexico 1960–2050 (Data source: United Nations 1998)

based on this result and other statistical qualities of the models is that the FAO 1995 data are more valid and reliable than the FAO 2005 data.

Corruption was one of the statistically significant independent variables in the global model (Table 5.10). This variable was not available in our Mexican models (Table 5.9). However, in our comparison of Mexico with Costa Rica and Chile we found that Mexico had the strongest corruption (Table 5.11). Therefore, we may assume that it would also be operational in Mexico, if a valid and reliable variable would be available sub-nationally.

Bray (2010) has reviewed a number of deforestation and forest transition studies in Mexico and Central America. He observed at the sub-national level the Monarch Butterfly Biosphere Reserve in Michoacan Highland in Mexico state that has had rapid deforestation over the last several decades due to heavy illegal logging and agricultural expansion (Photo 5.15). However, the protected areas, up to 8% of the federal land area, have played an important role in lowering deforestation. The decline in deforestation might occur due to the decline in large-scale directed and spontaneous colonization.

"Evaluating all of these dynamics, it does not appear that Mexico as a whole is approaching a forest transition, but much more work remains to be done at identifying precise regions of forest loss and recovery. Nonetheless, a complex large-scale landscape dynamics can be glimpsed which suggests lower deforestation pressures and forest recovery, and the beginnings of a forest transition in some southern tropical areas, particularly in the Yucatan Peninsula in central Quintana Roo, the region around the Calakmul Biosphere Reserve, and the northern Lacandon forest. However, tropical deforestation likely continues along the Pacific and Atlantic coasts, particularly in dry tropical forests. At the same time, while most regions of

Table 5.11 Poverty (HDI), corruption (CPI), and income per capita (GDP/capita) in Mexico, Costa Rica, and Chile

	HDI rank	CPI rank	GDP/capita (USD)
Mexico	53	70	5,968
Costa Rica	48	55	4,534
Chile	38	20	5,448

Data sources: UNDP (2006), Transparency International (2006), FAO (2006)

Photo 5.15 Monarch butterfly has its home habitat in a protected forest in Mexico state but it migrates annually about 8,000 km up to British Columbia. When the habitat forest became protected the livelihoods of the local people deteriorated. Children try to sell souvenirs to tourists (Photo: Jurgen Hoth)

the highlands may show forest cover stability in total area, particular areas are showing accelerating deforestation, becoming temperate zone deforestation hotspots" (p. 98 in Bray 2010).

Papua New Guinea is covered by 29 million ha of forests. It has the largest intact tropical rainforests in the Asia-Pacific region. About 97% of its forests are under community ownership by some 8,000 traditional autonomous tribes. More than a half of the total forests are committed to industrial logging, mostly by foreign companies.

From 1990 to 2010 deforestation has continued in Papua New Guinea by about 0.14 million ha a year. Widespread corruption and illegal logging are continuing. Community forest ownership did not differentiate Papua New Guinea from the tropical countries with prevailing public ownership of forests or from the continuous deforestation in Mexico (FAO 2010a; Filer and Sekhran 1998).

There exist a high number of proponents of devolution of public forests into community forests (e.g., Bromley 1991; Ostrom 1999; White and Martin 2002; Humphreys 2006), but quite a few in favor of private forests as in Finland of our Chap. 4 (e.g., Siry et al. 2009).

However, the world exhibits a number of other sustainable forestry countries with private forests dominating and at higher forest covers than the global average (30%). Such countries include the United States, Sweden, Finland, Norway, France, Austria, Japan, South Korea, and Costa Rica (FAO 2006).

Eight of the above countries belong to the industrialized countries. In the tropical countries, however, insecurity, high transaction costs, poor, partial and arbitrary enforcement of rights due to weak judiciary and constitutional laws, and lack of infrastructure can seriously constrain the efficiency of private and community property rights (Sect. 2.5; Bulte and Engel 2006). On the other hand, Costa Rica exhibits a case where these reservations can be overcome even under the tropical conditions (Box 5.3).

Box 5.3 Case Study of Forest Transition in Costa Rica

Costa Rica lies between Panama and Nicaragua in Central America and has a total land area of 51,000 km², of which 51% is covered by forests. It has a population of 4.5 million people and population density of 89 inhabitants per km² in 2008. The total forest area decreased dramatically during 1950–1989 and further still during 1990–2000 from 2.6 to 2.4 million ha, but returned back to 2.6 million ha by 2010. A likely forest transition has taken place (FAO 2010a).

Costa Rica had GDP per capita of 9,460 USD (PPP) in 2001. It presented a Human Development Index (HDI) of 0.832 and a rank of 42 among 151 countries assessed by UNDP (2003). Life expectancy at birth was estimated 77.9 years. The rank of Costa Rica in Corruption Perceptions Index was 55 from the least corrupted country, while Chile was ranked 20 and Mexico 70 (Transparency International 2006). We may consider this rank 55 lying at a workable level.

Costa Rica has been a stable democratic country without any army and wars for 63 years. Accordingly, more funding has been available for allocation to education, health care, and poverty alleviation. Therefore, a number of international institutions have been located in Costa Rica. CATIE (Photo 5.16) and University of Peace have been running graduate programs in forestry and natural resources and related research. This has consolidated the easy access to the relevant information, innovation, and consultant services. I have been for many years a visiting professor to both of these institutions.

The first generation of public incentives for forestry prevailed from 1979 to 1988. The tax exemptions, however, favored primarily the big landowners.

(continued)

Box 5.3 (continued)

Photo 5.16 Main administrative building of CATIE at Turrialba, Costa Rica with partially deforested slopes at the background (Photo: Matti Palo)

The second generation was enforced from 1988 to 1995. This benefited also small and medium-sized farmers. The third generation was launched in the new forest law of 1996. This was a revolutionary one, because it supported not only tree planting but for the first time in the world history of forestry also forest ecosystem services.

The 1996 Forest Law identified the following forest ecosystem services: (1) mitigation of greenhouse gas emissions; (2) water protection for urban, rural or hydroelectric uses; (3) protection of biodiversity for its conservation, sustainable, scientific, and pharmaceutical uses; research and genetic improvement; protection of ecosystems and life forms; and (4) provision of natural scenic beauty for tourism and scientific purposes.

Costa Rica created in 1997 a program of payments for environmental services (PES). It was funded by a new tax on cars. The principle "polluter pays" was followed. A National Fund for Forestry Financing (FONAFIFO) was created for the enforcement of the program. The whole national territory was considered as a priority for this program. However, the National System of Conservation Areas SINAC could identify some priority areas among its multiple management units.

(continued)

Box 5.3 (continued)

The implementation of PES is expected to increase the various forest ecosystem services. A study was made to compare the outcomes of PES-forests and non-PES-forests between 1998 and 2004. The findings by quantitative modeling indicated that deforestation of natural forests had slowed down and reforestation significantly increased in the PES-supported forests of 0.5 million ha of conservation contracts. The interpretation of the results was that PES had made an important impact on forest transition underway in Costa Rica.

A national forest development plan was completed under a participative process in 2001. It contained the following components: forest land planning, competitiveness and positioning of the forest sector, follow-up, control and evaluation of the sustainability of the forest activities, instruments and mechanisms of financing, systems of information, and interinstitutional strengthening and coordination (MINAE et al. 2002).

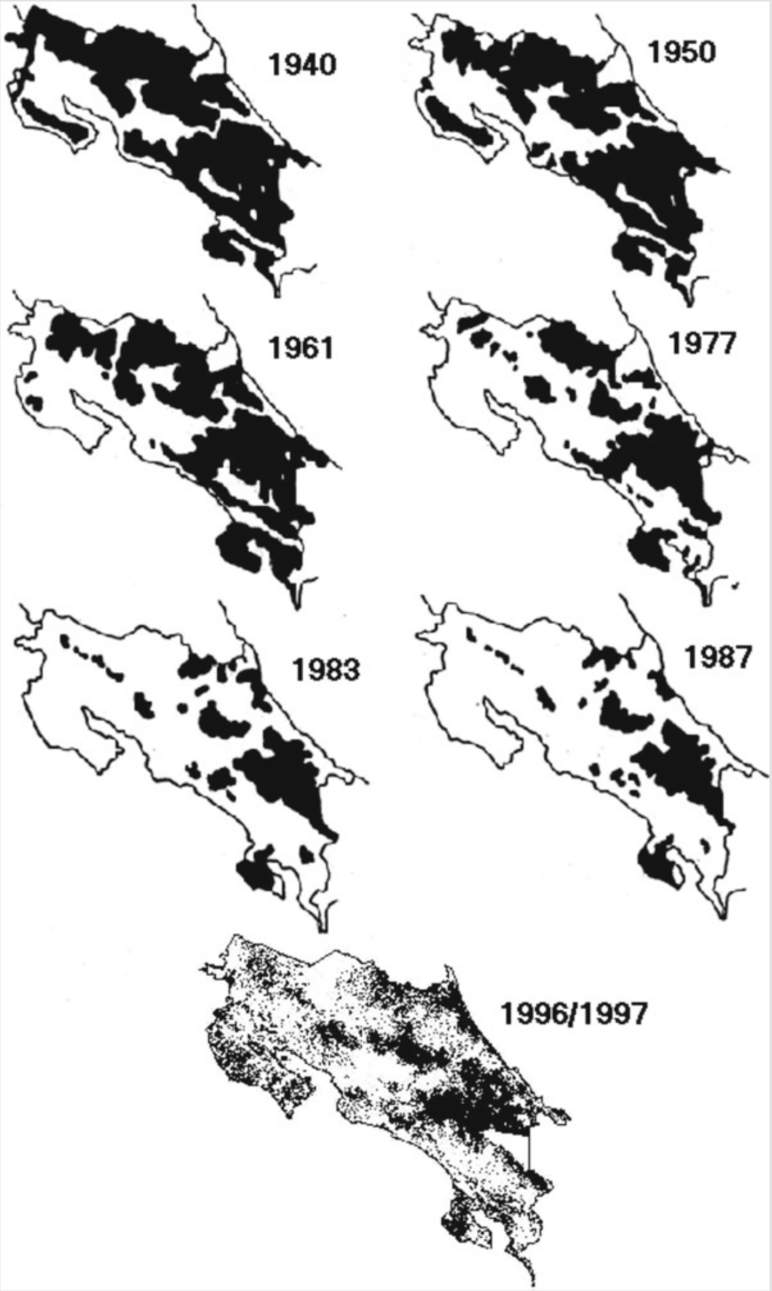
Costa Rica has recently not only stopped deforestation of natural forests (Map 5.3), as just about the only noteworthy tropical forest country, but also created markets for biodiversity, ecotourism, watershed protection, and carbon sequestration as new value creating forestry services. Costa Rica signed a contract with Norway in 1997 of selling 200,000 ton of carbon by gaining USD 10 per ton of carbon fixed by forests. This kind of services-based forest development can be regarded as unique in the world and highly interesting as a case study country (Arriagada et al. 2010)

Private forest ownership dominates in Costa Rica by 55% (FAO 2010a). Tourism has become the most important export earning in Costa Rica. When 27% of the national forest area is protected, the numerous national parks have become increasingly popular tourist attractions. In addition to markets in ecosystem services, stumpage markets are operational. Accordingly the value of forests has been increasing. One way in this front has been agroforestry (Photo 5.17).

As a case of forest-based tourism as a forest service I can describe a private family-owned farm, Rancha Naturalistra, with 100 ha of forest at 900 m elevation 25 km from Turrialba, where I visited some years ago. Bird-watching, especially of multiple hummingbirds, along beautiful nature trails is the special attraction of the farm. It has 15 beds for accommodation and serves meals and refreshments. The farm employs 17 persons from the nearby village all year round and four ornithologists seasonally. The farm supports financially the education of the children of the village and the villagers in response observe and protect the farm's forests from illegal logging and hunting.

(continued)

Box 5.3 (continued)



Map 5.3 Forest cover change in Costa Rica in 1940–1997 (*Source*: FONAFIFO 1998)

(continued)

Box 5.3 (continued)

Photo 5.17 Coffee grown under commercial shade trees at Turrialba, Costa Rica. When coffee prices are good coffee is picked for sale, but when they are bad shelter tree timbers are cut and sold (Photo: Matti Palo)

5.5 Role of Tropical Forests in Alleviation of Poverty

5.5.1 Introduction

The purpose of this section is to analyze underlying causes of poverty in tropical countries with a particular reference to the roles of natural forests and plantation forests as well as to agricultural productivity and corruption in alleviating poverty.

The Millennium Declaration by the United Nations (UN) in 2000 has been adopted by 189 countries. Poverty reduction and environmental sustainability are among the eight goals of the Declaration. UN declared halving the number of the extreme poor and of the people suffering from hunger by 2015 as the first goal (UNDP 2006).

Most tropical countries, especially in Africa, belong to the poorest groups when measured by the Human Development Index (HDI). HDI is composed of health, education, and income components (UNDP 2006). HDI is considered as one of the best indicators of poverty available at the national level (World Bank 2001; Björk 2009).

Photo 5.18 A poor shifting cultivation family next to their modest wooden house, Mindanao, the Philippines in 1990 (Photo: Martti Saarilahti)

Deforestation of natural tropical forests has been continuing with a pace of about 12 million ha per year as an average during 1990–2005 (FAO 2006). Unfortunately, FAO (FAO 2001b, 2006, 2010a) no longer reports the situation in the tropical forests separately, as was the case earlier (FAO 1993b).

"While the deforestation rate for the tropical countries for the 1990s did not change significantly as a result of this additional information, the inclusion of countries in the temperate and boreal zone made a significant difference" (p. 22 in FAO 2010a). We may deduce from these scanty hints that hardly any slowing of tropical deforestation of natural forests has taken place between 1990 and 2010.

Poverty and forests (Photo 5.18) have been studied at the sub-national level in seven tropical countries. Populations in or near forests tend to have a high poverty rate and to experience severe and chronic poverty. Their survival is highly dependent on forests. Fuelwood, construction materials, shifting cultivation sites, fruits, honey, edible animals, plants, insects and fungi, and cultural and spiritual satisfaction are all discovered in forests. However, most poor people live closer to urban centers outside locations of high forest cover (Sunderlin et al. 2007).

Opportunities for poverty reduction by forests (Photo 5.19) with Clean Development Mechanism, environmental services and biodiversity were studied both at sub-national and national levels primarily in the Asian tropical countries (Sim et al. 2004).

The relationship between poverty and forests has also been studied at the national level. The motivation has appeared as an interest in the role of poverty as one of the underlying causes of tropical deforestation (Dasgupta 1982; Sect. 5.2; Hobley 2008).

However, we found no other study besides Palo and Lehto (2011) on the role of forests in poverty at the national level. We think that national-level findings on

Photo 5.19 If alleviation of poverty were successful, even a wooden house would be elegant. Mindanao, the Philippines (Photo: Martti Saarilahti)

causes of poverty are essential before effective instruments can be mobilized at the sub-national level.

5.5.2 *Poverty Alleviation*

A number of definitions for poverty exist (Angelsen and Wunder 2003; Björk 2009). The World Bank (2001) adopted a three-dimensional concept of poverty: opportunity, security, and empowerment. Security refers to the risk of people falling below the poverty line or other welfare indicators. Empowerment means access and control over local resources, public services, and influence in local decision-making.

Security and empowerment are valid aspects of poverty but their quantitative measurement at the national level is problematic. Opportunity includes income, education, and health. Therefore, it is quite similar to the HDI, which we have adopted as a measure of poverty here. For modeling purposes we have used inverted HDI: when its value is increasing – poverty is also increasing.

Poverty alleviation is a complex undertaking (Photos 5.20 and 5.21). From a historical perspective economic growth per capita has been a necessary but not a sufficient condition for poverty alleviation (Sachs 2005). Economic growth alone will not necessarily lead to a distribution of income, education, and health (HDI) favorable for the poor.

Therefore, we need a theoretical frame of sustainable livelihoods in order to find out the role of forests in this process. Forests alone cannot make any major progress

Photo 5.20 A logging yard with heavy machinery, Kalimantan, Indonesia, in 1996. Highly mechanized logging has been prevailing in the tropics. It has provided only a little employment to the locals. It contrasts the situation in the forest transition in Finland (Chap. 4) (Photo: Erkki Lehto)

Photo 5.21 Truck haulage of tropical logs, Kalimantan, Indonesia, in 1996 (Photo: Erkki Lehto)

on this front. The theory is based on a simultaneous attack on poverty by five instruments: natural, financial, human, social, and physical capitals (Cahn 2002).

Most countries with large poverty suffer from conditions that hinder the take-off to economic growth. After the take-off phase has been overcome, stepping up the ladders of economic development is an easier process (Sachs 2005). The economic growth theories do not give too much policy advice on how to implement a successful take-off from poverty.

A success in poverty reduction is dependent on the access to all of the five kinds of capital. Accordingly, a conceptual deduction can already be made, that in poverty alleviation access to forests as only a kind of natural capital can alone play a rather limited role, if access to the other four capitals is not also simultaneously available.

Dasgupta (1982) identified a vicious circle with poverty and deforestation. A higher population density at low levels of income consumes more forest products and increases deforestation in the tropics. A poorer forest environment increases poverty, which in turn increases population density in the remaining forest and so on. The two assertions are supported by our empirical findings that poverty alleviation is reducing deforestation (Palo and Lehto 2011).

The process of the simultaneous causal impacts of poverty on deforestation and of deforestation on poverty is defined as coevolution (Norgaard 1984). This specification provides us the rationale to empirically model separately the underlying causes of both deforestation and poverty.

5.5.3 Poverty and Forests

We assume that natural forests represent one kind of natural capital. Access to ample natural forest resources provides time-saving access to direct subsistence in the form of food, fuel, construction material, water, and medical plants for local people. Forest-based industrialization is another indirect way to reduce poverty in countries with abundant forest resources (Westoby 1962; Wardle et al. 2003). We simply believe that the more natural forests, the less poverty.

Industrial plantation forests have primarily been established as financial investments for future sawnwood and plywood production as well as for pulp and paper. These plantations are assumed to indicate financial capital and to increase employment and income and thus to decrease poverty.

Plantation forests have, however, also been established for social and environmental purposes (Del Lungo et al. 2006). These plantations are assumed to improve fuel service by reducing gathering time and by producing higher quality fuel than previously. With improved fuel service it is also possible to prepare healthier food and save women's and children's time for education. Environmental plantations protect agriculture and in that way improve harvests. Therefore, we assume that increasing plantation forest cover is decreasing poverty.

On the other hand, contrasting findings came out in our previous study on expansion of plantation forests (Sect. 5.3). There the increase in poverty increased plantation forests in a multiple variable regression analysis of 71 tropical countries. On the other hand an increase in poverty reduced plantation forests in our modeling of the 37 less poor tropical countries.

Niskanen (2000) analyzed not only financial profitability of Acacia-plantation forests in the Philippines but also economic profitability by increasing tax income, subtracting subsidies, using 5%-units lower discounting percentage and with some other minor adjustments. The internal rate of return to the society was from 13% to 19% or about 4% higher than the financial internal rate of return at each of the three slope classes.

Then, on-site value of erosion control, off-site value of erosion control, value of nutrient loss, and value of carbon sequestration were also considered in the environmental-economic cost-benefit calculations. The environmental-economic profitability of the Acacia plantation forest was raised to 16–20% by slope class (Niskanen 2000).

The positive correlation between poverty and inverted relative natural forest area in 74 tropical countries was illustrated in Fig. 5.11. Here we estimated a two-independent-variable regression on poverty in the same 74 tropical countries. Natural forests and plantation forests jointly explained 25% of the variation of poverty (HDI) in 2004 (Fig. 5.14). The alleviation of poverty is not, however, feasible with access to natural forests and plantation forests only. The simultaneous five capital approach is needed.

5.5.4 Poverty, Agriculture, and Corruption

In order to increase agricultural productivity an increasing extension to human capital is needed among some other favorable factors. An increase in productivity will expand food accessibility and increase life expectancy and thus alleviate poverty.

A crucial question is whether to expand agricultural production either via extensification or intensification. The former will take place by clearing forest under high opportunity cost for sustainable forestry. The latter is favored in the opposite case. Under the intensification option deforestation will be decelerated and more natural forest will reduce poverty.

We estimated another two-independent-variable regression on poverty. Natural forests and agricultural productivity had statistically highly significant regression coefficients and they jointly explained 47% of the national variation of poverty in 74 tropical countries in 2004 (Fig. 5.15; Palo and Lehto 2011). This degree of explanation with only two variables and using cross-country panel data can be regarded as comparatively high. The two independent variables also support each other: increasing agricultural productivity is decelerating deforestation and the more natural forests a

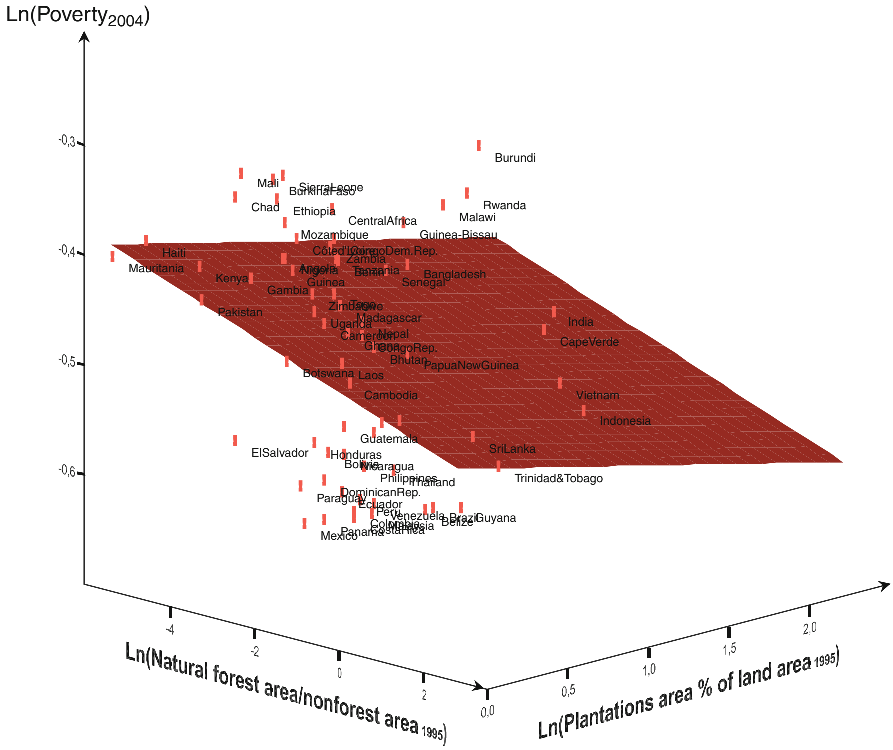


Fig. 5.14 Poverty as a function of natural forest area and plantation forest area in 74 tropical countries. Weighted adjusted R square = 0.25 (Data sources: UNDP 2006; FAO 1999)

country has the better agricultural conditions and productivity due to the protection effects of forests.

Finally, we define corruption as an indicator of negative social capital. A high degree of corruption undermines both effective governance and efficient markets. Consequently, sustainable economic growth is hindered and health and educational services also become more expensive. Therefore, we assume that increasing corruption will increase poverty (Klitgaard 1988).

An indirect effect of corruption on poverty can be identified via deforestation. Corruption tends to exclude market pricing under socialistic forestry (Sect. 5.1), which is prevailing in the tropics. The stumpage prices are set administratively so low that the social opportunity cost of sustainable forestry becomes high enough to facilitate forest clearing. In this way, deforestation will continue and decreasing forest resources will increase poverty.

In our multiple variable regression modeling natural and plantation forests, openness of trade, agricultural productivity, the degree of urbanization, corruption, and the continental location of the country jointly explained 91% of the national variation of poverty in the 74 tropical countries in 2004 (Palo and Lehto 2011). Accordingly,

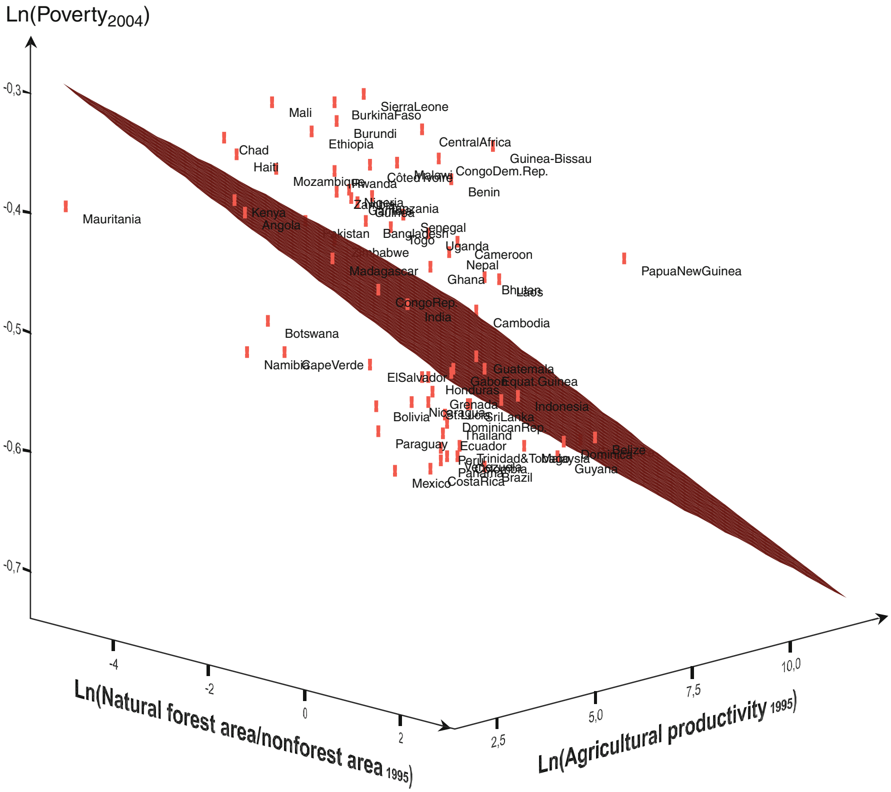


Fig. 5.15 Poverty as a function of natural forest area and agricultural productivity in 74 tropical countries. Weighted adjusted R square = 0.47 (Data sources: UNDP 2006; FAO 1999; World Bank 1999)

we have a clear idea of the underlying factors of the variation of poverty by 74 tropical countries, which cover 96% of the total human population in the tropics.

5.5.5 *Discussion*

López and Galinato (2005) adopted the percentage of people living below the international poverty line as their dependent variable in their poverty model estimation, whereas we used HDI, which we regard as more valid for the purpose. They had observations from 26 developing countries from 1980 to 1998. The estimation identified six out of ten independent variables as statistically significant. Among those variables were two similar to ours: openness of trade and share of rural population. They did not include any forest data as independent variables.

We have not seen before similar modeling as described in this Sect. 5.5. We applied an integrated three-dimensional indicator of poverty – the HDI – in the dependent variable. We were able to show that natural forests and plantation forests jointly explained 25% of the national variation of poverty (Fig. 5.14). Natural forests and agricultural productivity jointly nearly doubled this explanation (Fig. 5.15). A deduction can be made that agricultural productivity alleviates poverty more strongly than plantation forests.

Some representatives of NGO's argue that increasing plantation forests expand poverty (e.g., Lang 2007). This may happen under some specific sub-national conditions but our own modeling shows that at the national level the contrary is true, or increasing plantation forests alleviate poverty.

Increasing natural forests and plantation forests are alleviating poverty at the national level in the tropics. However, forests are reducing poverty most effectively under the context of five other socio-economic-environmental variables. Alone their impact on poverty alleviation may remain negligible. Also a favorable institutional setting is needed. Under socialistic forestry (Sect. 5.1) the poverty alleviating impact of natural and plantation forests will remain modest.

5.6 Wild West in Uses of Forest Data in Deforestation Studies

> The first step in the right direction, and therefore perhaps the most important, is the reader's realization that he must treat statistics objectively and that he should never accept them at their face value. (p. 14 in Reichmann 1981)

5.6.1 Introduction

The purpose of this section is to analyze the validity and reliability of national forest area and deforestation area data provided by different FAO sources. We explain here why we have used in our modeling stock data (relative forest areas) instead of change data (deforestation areas). Deforestation modelers should pay due attention to the quality of empirical forest data, that they are using as inputs in their modeling. Poor quality input data can only produce poor modeling findings.

"The Causes of Deforestation in Developing Countries," by Allen and Barnes (1985), has received classical status among references. They picked up their annual forest and woodland area data from the FAO Production Yearbook of 1980. Deforested area was computed by subtraction of forest areas in 1978 from those of 1968. This source was selected because of its broad forest definition and because it covered "more countries and more years" than other available sources. Surprisingly, the authors made no evaluation of the validity and reliability of these data. FAO stopped publishing the data in 1995 due to their poor quality.

The findings by Allen and Barnes (1985) have been based on low-quality data and therefore they remain unreliable (Palo 1999c). National forest areas are always

estimates with higher or lower quality depending on the method and the application by which they have been produced. Astronomers or geneticists would never start analyzing any observations without careful evaluation of the validity and reliability of the data.

Why would I want to mobilize a serious discussion on this quarter-century-old issue? I became shocked shortly by reviewing a number of recent deforestation studies, where forest area data were still based on the FAO Production Yearbook and positive references were made to Allen and Barnes 1985 (e.g., Culas 2007; Foster and Rosenzweig 2003; Bhattarai and Hammig 2001; Koop and Tole 2001).

One example of a total misunderstanding concerning reliability with three supporting references is given as follows: “The FAO Production Yearbook data is more reliable and covers more countries and spans a longer period than other sources” (p. 432 in Culas 2007). In reality the reliability of those data is intolerable.

Grainger (1996) criticized strongly the FAO 1990 Tropical Forest Resources Assessment. Lately, he has compared with great publicity the FAO 1980, 1990, 2000, and 2005 assessments and found no clear trends of deforestation of tropical natural forests (Grainger 2008). However, he did not use the available remote sensing surveys by FAO (1996, 2002), which had been designed to reveal the long-term pan-tropical deforestation.

Lomborg (2001) was also highly critical on the existence of tropical and global deforestation. He insisted that global forest cover was 30.04% of the land area in 1950 and 30.89% in 1994. The former figure was based on the world forests assessment by FAO, and the latter on FAO Production Yearbook. The comparison is surprising and not valid due to poor quality of the two data sources! Both assessments are invalid for this kind of trend. Lomborg already had available, but did not use, the first remote sensing assessment of tropical deforestation (FAO 1996): tropical deforestation had been of 9 million ha/year as an average in 1980–1990.

The authors above did not master the specialized discipline of this field: forest inventory and mensuration. Its existence may also be unknown to a number of other deforestation modelers. Otherwise, it is difficult to understand the “Wild West” practice in the total neglect of evaluating the quality of the available deforestation area data in different sources.

Monitoring of forest resources aims at providing information about the state of forest and the changes in its condition for observing deforestation and supporting sustainable forest management at sub-national, national, regional, and global levels. This information serves decision making, research, and the public at large at the various spatial levels.

A monitoring system for a forester plays a similar role as a telescope for an astronomer or a microscope for a geneticist. The quality of observations, such as forest area, its change (area of deforestation or forest expansion), growing stock, its increment, produced by monitoring systems depends on the relevancy and quality of the monitoring system itself as well as on the expertise of the staff in its implementation.

I will first review the quality of forest area data in the FAO Production Yearbook and then describe forest inventory and mensuration as a discipline. Next a two-stage review of global forest monitoring and assessment by FAO will be given. The evaluation

of the 2010 global forest resources assessment is introduced separately. Finally, a conclusion of uses of forest area data in deforestation modeling will be introduced.

5.6.2 FAO Production Yearbook

FAO Production Yearbook was published by non-foresters of the Statistics Division of FAO. At the same time the foresters and forest scientists at the Forestry Department of FAO had been assessing tropical forest resources data with increasing intensity since the middle of the 1970s.

An example of a biased reference to this activity follows: "FAO's annual data on forest and woodlands area are projections based on forest inventories done at 10-year intervals…" (p. 998 in Bhattarai and Hammig 2001). This is not true. No such projections were executed by FAO. The Statistics Division used to mail annual questionnaires to member governments of FAO. The respondents were mostly agronomists, and not familiar to the discipline of forest inventory and mensuration. Therefore, they just responded by subjective guesstimates, when mostly the relevant data were missing. FAO published these data in 1962–1995. After that period Table 1 of the FAO Production Yearbook no longer comprised the data on forest and woodland areas (FAO 1997a). Since then there has been a reference: contact the Forestry Department of FAO.

FAO Production Yearbook defined forest and woodland as follows: "Land under natural or planted stands of trees, whether productive or not. This category includes land from which forests have been cleared but that will be reforested in the foreseeable future, but it excludes woodland or forest used only for recreation purposes." This is a weak definition to support the delineation between forest and non-forest area, which added one more problem in national reporting.

"If one bears in mind the fact that by the end of 1970 not a single tropical country had undertaken a nation-wide inventory, replying to a questionnaire in a precise manner must have been a difficult, if not impossible, task. The source of data provided by the national forest authorities for the world forest inventory has been mostly "official statistics," which often reflect the nominal rather than actual status of forest resources of the country. These numbers aggregated to regional and global levels produced estimates of unknown reliability and significance" (Marzoli 2001).

Production of valid, accurate, precise, and reliable annual data on national forest areas has not been feasible in the past. The advancement of the scientific discipline of forest inventory and mensuration has, however, lately changed the situation. With the help of up-to-date remote sensing supported multi-source forest inventory schemes it would be feasible for a few most advanced countries.

Under cost restraints, only a few countries have so far implemented such an annual practice. For the great majority of countries the annual production of high-quality forest area data will remain a distant dream. For most countries, it would not even be advisable to strive toward reliable annual reporting – valid and reliable periodic reporting would be enough.

5.6.3 Forest Inventory and Mensuration as a Discipline?

Why has a special discipline been developed during more than two centuries to measure and inventory trees and forests?

Finland alone has 77 billion trees on 22 million ha of forest (Korhonen and Mäkelä 2009). Finland has only 0.5% of the forests of the world (FAO 2006). The forest areas and number of trees are in a continuous dynamic change and are so large and numerous that total tallies are impossible in large forest areas due to time and budget constraints. The concepts of a tree and of forest are fundamental for forest inventories.

What is a tree (Alvarado et al. 2001)? A tree is defined in Finland for national forest inventory purpose as a perennial plant higher than 1.3 m containing wood material with one main stem (Korhonen and Mäkelä 2009). FAO (2006) defined a tree internationally as a woody plant to reach a minimum of 5 m height in maturity. An international team of experts recommended a definition as follows: "A tree for national forest inventory purposes is a woody perennial of a species typically forming a single self-supporting main stem and having a definite crown" (p. 306 in Gschwantner et al. 2009).

It is mandatory to have a relevant tree definition to understand what a forest is. A relevant forest definition is mandatory to identify deforestation, which requires delineation between forest and non-forest areas.

No tree is identical to any standard geometric form. Therefore, no geometric formula can be used to estimate the exact volume of a tree stem. The volume of the whole tree, including roots and branches, makes the measuring even more complex. Instead, a high number of equations to approximate the tree stem volumes have been developed by forest mensurationists during the last two centuries. During the most recent decades mathematical polynomials have appeared the best estimators of the relative taper curves as basis for estimating tree volumes (Laasasenaho 1982). An interesting finding was that the relative taper curves were rather similar to trees of different species and sizes.

There exist no identical trees – they are all of different absolute form or size. Special instruments, models, and methods are required to measure the volume, biomass, carbon stocks, and annual growth of trees. Trees also grow in random spacing, which prevents an easy tallying of them. Tree growth is a complex biochemical process, which does not allow any simple measuring of it but requires its own methods and instruments.

The assessment of volumes and biomasses of growing and dead stocks of trees are always less reliable than assessing of forest areas. The more complicating factor is that the volume data are desired mostly by tree species. While Finland in the boreal zone has only a total of 24 indigenous tree species (three commercially important ones), Brazil in the tropics has 7,880 tree species, each of them with different properties (FAO 2006).

Therefore, in our tropical deforestation modeling we have used forest area data and not the less reliable volume data of growing stocks (Palo et al. 2000; Uusivuori et al.

2002; Palo and Lehto 2005; Sects. 5.2, 5.3, and 5.4), although FAO has lately reported also them. Forest area is, however, a weak indicator of sustainable forestry, an idea that was documented already by a German forest mensurationist Judeich (1903).

Valid and reliable data on the volume, structure, and growth of growing stock of living and dead trees would facilitate follow-up of indicators for sustainable logging options, carbon stocks, and flows as well as some biodiversity. Remarkable decrease and degradation in growing stock can take place before the site will be recorded as a non-forest area. Crucial in this respect is the evaluation of such degraded site's potential resilience in due time back to forest.

Sampling design (random, stratified random, systematic, two-stage, etc.) and the shape (circular, rectangular, cluster etc.) and scale of sample plots depend on the data requirements, on ecological conditions, on infrastructure, available expertise, and funding. An optimum balance of sampling has to be designed also between ground truth, aerial photo, and space image sampling. There exist many reasons why reliable forest inventory cannot rely on remote sensing alone, but ground sampling is always needed (Tomppo and Andersson 2008).

Forests are not composed of only trees and soil but are also complex ecosystems of other plants, animals, and microbes with their physical environments and mutual interchanges and interactions with multiple inputs and outputs of matter, energy, and information. The primary global interest concerns the forest areas, growing stocks with volumes, biomasses, tree species, other biological diversity, and carbon contents and their changes (Tomppo and Andersson 2008; FAO 2006).

The numerous indicators of sustainable forest management have been lately added also to the FAO assessments (FAO 2006, 2010a). This makes the inventories today more demanding and costly than in the past (Tomppo and Andersson 2008; Tomppo et al. 2008). A risk has also appeared that less effort can be devoted to maintaining and improving the quality of the forest area and volume variables and their changes, when so many new assessment indicators have been accepted.

In our modeling experiments the 1995 forest area data of FORIS database of FAO gave the best fit with six socio-economic variables and two harmonizing ecological variables in comparison with the 2000 and 2005 forest area data (Palo and Lehto 2011; FAO 2001b, 2006). Our inference was that the quality of the data of 1995 was better than of the data of 2000 and 2005. We eliminated the possibility that this outcome was due to the updating modeling by also using the original country observations available in the FORIS database.

Forest inventory refers to both the tabulated forest data and to the process of measuring and analyzing the data. Traditionally, the tabulated data generally covers estimates for trees, tree species and properties, forest sites and forests, often on the basis of areal units. Forest inventory and mensuration focuses particularly those aspects of forest ecosystems, which play roles in decision making in forestry. Recently, more international cooperation has been mobilized in developing new theoretical and methodological bases for this discipline (Kangas and Maltamo 2006; Tomppo and Andersson 2008; Tomppo et al. 2010).

Forest inventory and mensuration as a scientific discipline has been applied at tree, forest stand, forest holding, subnational, national, continental, and global

levels. The discipline has a long history (Hartig 1795; af Ström 1830; Cajanus 1914; Ilvessalo 1924; Loetsch and Haller 1964; Schreuder et al. 1993; Kangas and Maltamo 2006; Tomppo and Andersson 2008; Tomppo et al. 2010). First, methods and instruments had to be developed for measuring individual trees, then forest stands and forest holdings. Until this end total censuses were feasible.

Larger forest areas at subnational and national levels due to the large scale did not allow inventories of total populations but sampling systems had to be developed. Israel af Ström (1830) in Sweden innovated the pilot idea of systematic sampling by applying parallel lines for forest inventory. Until the 1920s continuous inter-Nordic discussions went on in Sweden, Finland, and Norway on the reliability, accuracy, and precision of this method. Finally, methods for estimating the sampling error were developed (Lindeberg 1927). Forest scientists have been pioneering in developing systematic sampling applications and to some extent also its theory.

Finland was a forerunner in completing the first statistical sampling-based national forest inventory (Ilvessalo 1924; Box 4.13) in the world. The inventory was then based on field sample plots only. The plots were localized systematically on parallel lines through the country. Since then, there are only a limited number of countries that have implemented sampling theoretically sound national forest inventories in order to produce valid and reliable data on forest areas, growing stocks, and growth of trees. Still today, for example, Russia, Brazil, and Canada with 41% of the world's forests are missing more than one of such inventories in order to make reliable change estimates.

In Finland the university education of forest inventory and mensuration in 2009 was composed of the following components: mensuration of trees and forest stands, methods of forest inventory, sampling and remote sensing, modeling of forest development, multiple-goal forest planning, participative planning, group decision making and support for decision making, information systems for forest resources, and georeference systems (Haapanen and Hujala 2009).

5.6.4 FAO Tropical Country-Wise Forest Assessments

In Finland a forest is defined as including all lands with potential annual average increment of tree growth more than 1 m^3/ha/a by applying optimal rotations. FAO has encountered 650 different forest definitions in its member countries and their different inventories and assessments. This multiplicity has caused a massive effort for FAO in order to harmonize the various data sources to fit one global forest definition. This has added one more factor of inaccuracy in forest area data (Kangas and Maltamo 2006).

Since the 2000 assessment FAO has defined globally a forest as follows: "Land spanning more than 0.5 ha with trees higher than 5 m and a canopy cover of more than 10%, or trees able to reach these thresholds *in situ*. It does not include land that is predominantly under agricultural or urban land use" (FAO 2006). In the FAO 1990 assessment of the tropical forests a minimum area was 100 ha, a minimum tree height was 7 m, and a minimum crown cover in the industrialized countries was 20% (FAO 1993b).

Table 5.12 FRA 2000 – net and gross annual changes of forest area in developing countries in 1991–2000 (Marzoli 2001)

Continent	Net change	Natural forest change (1,000 ha)	Annual rate planting
Africa	−5,262	−5,460	198
Asia	−677	−4,178	3,501
Oceania	−121	−137	16
North and Central America	−958	−1,072	114
South America	−3,628	−4,138	510
Total	−10,646	−14,985	4,339

– Table shows clearly that separating deforestation from plantations, the picture is not so optimistic. The resulting annual deforestation rate for developing countries is −14.98 million ha/year, not far from the 15.4 of FRA 1990 (FAO 1993b), and actually more than the estimate made by FAO in SOFO 1997 (FAO 1997b) for the period 1990–1995 (i.e., –13.8 million ha).
– In this perspective the statement that deforestation is decreasing is questionable.
– In addition the use of aggregated data (net change) is prone to large errors, given the weakness of forest plantations data, which often refer to official national targets with no or limited control on plantation success rate.
– The FRA 2000 states that the global rate of forest change is −9 million ha per year, significantly lower than the previous estimate of −11.3 million ha (FAO 1997b). However this apparent decrease should be analyzed carefully, in view of the following:
– The deforestation rate officially reported refers to the *net rate or change*, including deforestation in natural forests and reforestation.
– Such estimate is spurious since it includes two distinct processes that are not comparable from many perspectives (carbon storage, biodiversity, commodities, environmental services, etc.), (Marzoli 2001).

The year 2000 was the first time in history that a single global definition of a forest was arrived at. It was surprising that the global forest area increased by 440 million ha for 1990 as a reference year. This was only due to this inflation of the forest concept in comparison with the previous separate definitions for industrial and developing countries (Marzoli 2001). Both the concepts of a tree and a forest have been politically loaded (Palo 1999a; Alvarado et al. 2001).

The total global forest area was estimated as 4 billion ha (FAO 2006) of which nearly a half is located in the tropics (FAO no more reports tropical forests separately in the tables as was the case still in FAO 1993b). To reach these estimates requires forest assessment and inventory. The global totals and the national totals are statistical estimates with a potential for sampling, measurement, and definitional errors and inexact measurements of totals.

In the FAO 2000 assessment among the 137 developing countries only 22 had repeated inventories, 54 relied on a single inventory, 33 on a partial inventory, and 28 had no inventory (Kangas and Maltamo 2006). Only a few countries could produce statistical confidence intervals for forest areas or changes of forest area (deforested area) (Table 5.12).

Matthews (2001), supported by Marzoli (2001), criticized the net deforestation concept of the FAO 2000 assessment. According to her interpretation “Global deforestation is probably not slowing down....” She continued: “The quality of forest

data in many developing countries is still so poor that it is too early to draw firm conclusions." She concluded that there is an urgent need for greater efforts at national and international levels to improve the quality of the available information.

Estimating a change, e.g., in national forest area (deforestation area), becomes more demanding than assessing a single years state variable (Poso 2006; Varjo and Mery 2001). Ideally two subsequent inventories with the same forest and tree definitions and classifications as well as similar sampling designs are required in order to produce accurate, precise, reliable, and valid estimates of forest area changes. The same permanent sampling plots would guarantee the least sampling error. This has hardly ever happened in developing countries.

A minimum of three subsequent inventories are needed to reveal the function form (linear, non-linear, etc.) of deforestation, which is essential for valid updating and scenarios. Until today two similar national forest inventories may have taken place only in a handful of countries in the whole world and none in a tropical country. Three or more similar inventories are even rarer cases.

The Forestry Department of FAO made the first scientific effort to assess forest resources in the tropics in 1990 (FAO 1993b). The consultants visited most important countries and gathered with local expertise all the assessments available based on common pan-tropical definitions, classifications, and by establishing a FORIS database for storing these original data. 1990 was the base year but the national data came from various years between 1970 and 1992. The original data were also stored in FORIS. This practice has not been continued in the later assessments.

A Chapman-Richards model was applied for updating the original forest areas to 1990 (Scotti 2000). The model had three independent variables: lagged forest cover, ecological zone, and population. This model was an improvement to the previous assessment of the tropical forest resources (Lanly 1982), where the updating was done subjectively by the seven French consultants and where no original observations were stored.

The average year of the original data by the national reports was 1994 with random variation to both directions in the FAO 2000 assessment. The updating to the reference year 2000 was done by expert opinions or maintaining the previous year observation constant or by linear extrapolation in cases of two or more assessments (FAO 2001b). The 1990 FAO assessment considered the nonlinear function form of deforestation process. It was also more objective due to the explicit application of the updating model.

Grainger (1996) as well as Kaimowitz and Angelsen (1998) criticized strongly the quality, especially the updating procedure, of the FAO 1990 assessment. They pointed out that updating was done using human population as an independent variable. They did not notice that lagged forest cover and ecological zone variables jointly explained more than 90% of the forest area variation and population only the rest. They did not realize that in the FAO 1980 assessment (Lanly 1982) and in the post-1990 assessments the updating was executed subjectively. An objective updating is more scientific and reliable than a subjective way.

Furthermore, the original country reports from 1964 to 1991 were available for analysts in the FORIS database both nationally (90 countries) and subnationally (578 subnational units). That allowed the critics to do their own updating, if necessary. We compared both the original and the updated forest area data in our deforestation

modeling with very similar outcomes (Palo and Lehto 1996). Accordingly, later on, we applied mostly the updated forest area data. Therefore, the criticism on our paper by Kaimowitz and Angelsen (1998) was unfair. Later on, we also excluded population as an independent variable in our deforestation modeling with updated forest area data (Palo and Lehto 2005, 2011).

We have used forest area change estimates/deforested area estimates only for comparative purposes (Palo and Lehto 1996; Palo et al. 2000), because their reliability is lower than the reliability of forest areas. The standard errors for change estimates according to the sampling theory are always higher than for state (stock) variables.

For example, in the first pan-tropical remote sensing survey 1980–1990 the standard error of the pan-tropical forest area was ±3.6%, while the respective figure for the deforested area was ±12.4% or 3.6 times the standard error of the state variable (FAO 1996). In order to arrive at an estimate under 5% risk, a confidence limit of ± two times of the standard error is needed.

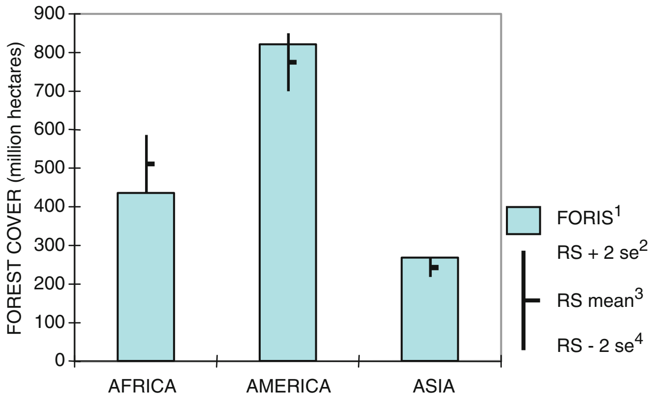
The second pan-tropical remote sensing survey, 1980–2000, also produced estimates on standard errors of the state and change variables. They are introduced in the graphics of the main report (FAO 2001b) and in numerical form in the special report (FAO 2002). Unfortunately, the standard errors were computed for the net deforestation areas and thus they were not comparable to the findings of the previous survey.

On the other hand, when two subsequent assessment projects are designed as one time exercises, the concepts and classifications also have usually changed from one assessment to the next one. For example, the change in forest concept from 1990 to 2000 included that a minimum forest area in developing countries was reduced from 100 to 0.5 ha. This was one reason why Africa's forest area increased by 101 million ha during that period.

Marzoli (2001) compared the estimates of tropical natural forest area in 1990 (Fig. 5.16) from the two independent sources: the country-wise 1990 assessment (FAO 1993b) with the remote sensing survey (FAO 1996). His conclusion was that with 5% risk the two sources gave supporting estimates. This finding falsifies Grainger's (1996) and Kaimowitz's and Angelsen's (1998) criticism against the FAO 1990 Assessment.

The FAO 1990 and the FAO 2000 assessments may have such big errors in the national total forest areas that the errors are bigger than the change in forest area between 1990 and 2000 (Marzoli 2001). Accordingly, we have used in our modeling mostly the total national natural forest areas of 1995. This updating has been available in the FORIS database. We have experimented with different dependent variables, e.g., forest area, forest area/land area, forest area/non-forest area (Palo et al. 2000).

When we have harmonized the ecological conditions of our sample tropical countries, it has been possible to identify by multiple variable regression modeling the socio-economic underlying factors, which have caused some countries to have less forest than some others. These factors we have interpreted to function as underlying causes of deforestation. In this way we have been able to use the more reliable state variables and not the less reliable deforested area variables.



[1] Estimates based on Forest Resources Information System (FORIS) database.
[2] Mean forest cover (definition F2) *plus* two standard errors based on remote sensing results (RS).
[3] Mean forest cover (definition F2) based on pan-tropical remote sensing survey (RS).
[4] Mean forest cover (definition F2) *minus* two standard errors based on remote sensing results (RS).

Fig. 5.16 Tropical natural forest area in 1990 by FORIS (FAO 1993b) and by remote sensing (FAO 1996). Confidence intervals of remote sensing with 5% risk (Marzoli 2001)

5.6.5 FAO Remote Sensing Monitoring of Deforestation

Grainger (2008) was interested about the trends in tropical natural forest deforestation. Why did he not use the only two surveys primarily designed for estimating the change in forest area? They are the satellite image sampling-based surveys of 1980–1990 (FAO 1996) and 1980–1990–2000 (FAO 2002). A new survey is reported to have been completed during 2011 (FAO 2010a).

"In contrast, the Tropical Moist Forest time series appears to show a long term rising, not declining trend" (p. 821 in Grainger 2008). In order to draw this conclusion, Grainger established his time series of several tropical forest assessments since the 1970s. This is a challenging task. I can be sure his conclusion was badly biased, when my conclusion is based on two remote sensing surveys by FAO (1996, 2002) as well as the time series of Fig. 5.17.

Figure 5.17 contrasts two centuries long time series of tropical rainforest area constructed by a competent forest inventory analyst, Walter Antonio Marzoli of Italy, who worked for many years for FAO 1990 Tropical Forest Resources Assessment. The potential initial forest cover is set to 1800. Since 1960 he has based his estimates on a number of FAO assessments, which he has studied with care, taking into account the differences in concepts and classifications.

"The comparison of the potential area with the time series 1960–2000 shows that most of the tropical rainforest loss has happened during 1960–2000. The overall

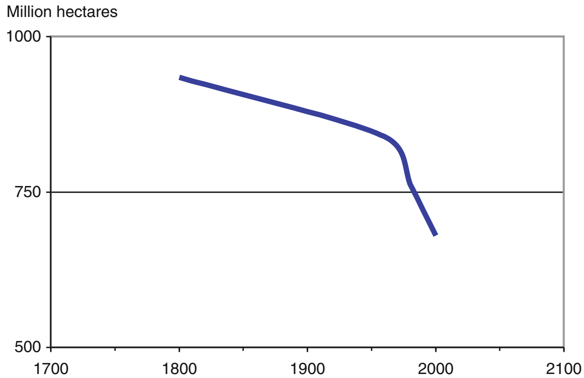


Fig. 5.17 Tropical rainforest area 1800–2000 (Marzoli 2000)

ratio of actual to potential rainforests was 90% in 1960 and has decreased to 73% in the year 2000" (Marzoli 2000).

K.D. Singh of India was the leader of the FAO 1990 assessment. He introduced also a totally new and objective way of pan-tropical assessment by remote sensing with 117 sampling units from 1980 to 1990 (FAO 1996). At the pan-tropical and continental levels the reliability of deforested areas by this assessment was tolerable but funding was not adequate to increase the number of samples to produce reliable data by countries.

Naturally, the validity of these change observations was high due to the same concepts, classifications, and procedures. In fact, this was the first pan-tropical assessment of forests with a specific sampling and observation design for estimating changes in forest areas, which became implemented all over the tropical countries with the same sampling units both for 1980 and 1990. The budget did not allow enough field checking, which is still vital to differentiate natural forests from various plantations and some other areas.

The remote sensing study was repeated for 2000 with the same 117 sampling units (FAO 2001b, 2002). This is the best forest area change or deforested area estimate available so far. This one gives equal decreases of about 9 million ha/a in tropical natural forest areas both for 1980–1990 and for 1990–2000. No statistically significant decrease at 5% risk in the deforested area during the two subsequent periods was observed either at the pan-tropical or continental levels.

The remote sensing survey covered 87% of the total tropical forest area. This is one reason why these results are lower estimates than the findings from the country-wise assessment. Anyway, this is quite a convincing objective assessment that a considerable declining trend in tropical natural forest area has occurred during 1980–2000, although Grainger (2008) was of the opposite opinion based on his biased analyses of the other FAO assessments.

I object also Grainger's "guesstimate" that natural expansion of natural forests has not been taken into account. It was estimated in both of the 2000 and 2005 assessments: e.g., 1990–2000 natural expansion estimate was 1 million ha/a (p. 9 in

FAO 2001b). For 2000–2005 it is not given as a number but the paper says that natural expansion of forests has been taken into account (p. 19 in FAO 2006).

Grainger made a lot of work by comparing the various trends from individual assessments – in vain. He only demonstrated what is clear for foresters with training in the theories and applications in national forest inventories and assessments! The individual assessments were not designed for comparisons of successive undertakings. They were designed only for a one-time purpose. FAO gave several warnings for that.

There are only a few countries that can base their reports to FAO on objective, scientifically designed, timely, and repeated national forest inventories. The rest or great majority of the countries rely in their reports on a varying mix of sources of variable validity, precision, and reliability. Reporting has become even more cumbersome since 2005, when the questions were increased to cover the seven thematic groups of criteria and indicators for SFM! Now there is less space even in reporting to process totals for tropical forests as a group of its own and various other forest categories separately.

5.6.6 FAO 2010 World Forest Resources Assessment

The world forest resources 2010 assessment by FAO (2010a) was available in the fall of the same year. It was the largest project of its kind to date, involving 233 countries and territories and more than 900 contributors. The FRA 2010 covers seven thematic elements of sustainable forest management: extent of forest resources, forest biological diversity, forest health and vitality, productive functions of forest resources, protective functions of forest resources, socio-economic functions of forest resources, and legal, policy, and institutional framework.

The main report of FRA 2010 provides text with numerous graphs, maps, and 20 global tables in 340 pages. It is based on country reports by the 233 participating countries and territories. The whole project is additionally supported by 177 working papers and a number of thematic papers and consultants. A really massive workload has been carried out primarily by the FRA 2010 project staff with country reporters under coordination of an international advisory group. We may assume that only a handful of people have read all the massive reports.

Our first critical comment concerns the summaries by regions and subregions. The totals for tropical forests are missing. We do not find directly, for example, the total of tropical deforestation, which is of actual global interest. It is even difficult to compute from the individual country data because a number of countries belong only partly to the tropics. In FRA 1990 the totals for tropical forests and deforestation of natural tropical forests were available for the readers (FAO 1993b) but in the later global assessments not. Why not serve the most expected topic ready-made for the readers?

Naturally FAO provides data enough for readers to make their own calculations (Table 5.13). Our findings are interesting. According to FAO (2006), no decelerating

Table 5.13 Forest area statistics of 92 tropical countries (cf. Table 5.5)

	FAO 2006			FAO 2010			
	1990	2000	2005	1990	2000	2005	2010
Natural forest area (million ha)	1,949	1,828	1,767	2,058	1,934	1,885	1,837
Plantation forest area[1] (million ha)	28	33	35	28	37	44	50
Total forest area (million ha)	1,976	1,860	1,802	2,085	1,972	1,929	1,887
Deforestation of natural forest (million ha/year)		12.1	12.1		12.3	10.0	9.6
Reforestation (million ha/year)		0.5	0.4		1.0	1.4	1.3
Deforestation of total forest (million ha/year)		11.6	11.7		11.3	8.6	8.4

Data sources: FAO (2006, 2010a); computed by Erkki Lehto; not published by FAO
[1]In FAO 2010 planted forests, which is the total of plantation forest + semi-managed forests

of deforestation has occurred during 1990–2005. Both assessments report the same deforestation rate from 1990 to 2000 but FAO (2010a) reports a lower value than FAO (2006) for 2000–2005. These annual deforestation areas have to be viewed as sampling estimates of change with their potential sampling errors.

At 5% risk two times the standard error estimate has to be considered. With a conservative estimate of relative standard error of ±10% (FAO 1996; Achard et al. 2002) we arrive to 12.1 ± 2.4 million ha as the estimate for annual deforestation during 2000–2005 by FAO (2010a). Clearly 10.0 million ha is within this confidence limit. Furthermore, the deforestation rates for 2005–2010 by FAO (2010a) carry only limited truth due to their “guesstimate” character under subjective extra-polations by the reporting countries.

A reader-friendly way of reporting deforestation would follow the model of Table 5.13. FAO should recall first that the group of the tropical countries is most interest among the readers. Accordingly, totals for the tropics are expected in the next report. Second, each of the deforestation indicators has their own readers. Deforestation of natural forests is of particular interest to ecologically oriented people who are worried about the environmental consequences of deforestation. Reforestation rates and changes in total forest area are in demand by development people and specialists in climate change. Why did FAO not make the global forest resources reports more accessible for readers?

Regions and subregions are often dominated by one mammoth country, for example, Russia in Europe and Brazil in South America. While Russia covers 20% of the total forest area of the world and Brazil 13%, it would have been more informative to report these giant forest countries separately. Mexico is reported in a total for North America, where the expansion of the US forests is covering tropical deforestation in Mexico. Similar groupings appear also in other regions. The rationale for this is the general FAO reporting practice. One would expect that FAO reports are also used for different purposes and that the country groupings could be tailored to support the readers’ needs.

"The reporting format required countries to provide the full reference for original data sources and an indication of the reliability of the data for each of these, as well as definitions of terminology. Separate sections in these reports deal with analysis of data, including any assumptions made and the methodologies used for estimations and projections of data to the four reference years (1990, 2000, 2005, 2010)" (p. 7 in FAO 2010a). No summary of the reliability of the data is integrated in the main report as was the practice earlier (FAO 1993b). No recommendation was visible in the main report for the interpolation and extrapolation of data for the reference years.

Russia, Brazil, and Canada jointly cover 41% of the total forest area of the world. None of them could provide reliable forest area data for the reference years. FAO never published these facts in the main report. Neither were other weaknesses in the reliability and quality of the data noted in the main publication. In the electronic country reports this key information can be found.

> The national data on forests of Russia given in TBFRA 2000 are based on SAFR-1993 years, which data are incomplete and have low reliability. (FAO 2010a/Russia)
>
> Since there was no systematized information at the national level on forests areas in each biome for the years requested by the FRA 1990–2010, the 2002-based mapping of the cover area of Brazilian biomes (PROBIO) was used as the reference value and estimates of the forest cover of biomes were made for the other years, based on the information available on the deforested areas and the deforestation rates for each biome, as presented below (FAO 2010a/Brazil).
>
> It should be noted that not all of the data in CanFI 2001 are up-to-date, and in some cases the data is more than 25 years old. About 20% of the data submitted for CanFI 2001 was also used in CanFI 1991. CanFI 2001 therefore does not lend itself to forecasting. The data figures from Canada's Forest Inventory 2001 were therefore used for all four reporting years (FAO 2010a/Canada).

A general rule prevails: the less developed the country, the less reliable data on forest resources. It had been fair by FAO to describe in the main report the reliability and quality of the data. Canada is ranked 8 in the Human Development Index (UNDP 2010) but has poor or no knowledge on the dynamics of its federal forest resources. Russia and Brazil have the respective ranks of 65 and 73 but also poor quality and lack of forest data. A greater number of tropical countries are identified below rank 73 and the quality of forest data also remains poor. It is unfortunate that FAO did not pay attention to the quality of data in the main report.

> First, I have indicated at several points my suspicion that information is a central variable in 'underdevelopment.' This idea has a descriptive aspect: the countries worst off on the indices of 'quality of life' are – I hypothesize – also worst off in terms of the quantity and quality of data, information-processing skills, 'intelligence' in the psychologist's sense, and, consequently, ignorance and uncertainty" (p. 207 in Klitgaard 1988).

FAO (2010a) published the latest forest data on 2010 without any warning of their "guesstimate" character, when the deadline of the submission of the country reports to FAO was already March 2009 (FAO 2010a). Finland has the longest history of the sampling-based national forest inventories. It has the most advanced national forest inventory methodology (Box 5.4) but was able only to report the same estimate for 2010 as for 2005. Many other countries had the same solution. No warning about this practice was given.

China as a unique case made formal extrapolation based on a linear trend for 2010. Perhaps a non-linear estimation and a scientifically specified equation had given a reasonably reliable estimate for 2010. When no guidelines on how to make this extrapolation were given by FAO, we may deduce that the 2010 estimates are of questionable reliability.

The headline of the global news release in the fall of 2010 was that deforestation was declining. The 2010 "guesstimates" played a decisive role in making this inference. The prime finding of the FRA 2010 was 13 million ha of annual deforestation globally from 2000 to 2010 and that it was 16 million during the previous decade (FAO 2010a). Earlier only 13 million ha/a was reported for 1990–2000 (FAO 2006). The 3 million ha/a ex post expansion was explained as follows.

> Additional information on afforestation and on natural expansion of forests for the past 20 years has now made it possible to take also into account deforestation and loss from natural causes in those countries that have had an overall net gain in forest area – including four of the five countries with the largest forest area in the world. As a result, the revised estimate of the global rate of deforestation and loss from natural causes for 1990–2000 (close to 16 million ha per year) is higher, but more accurate, than was estimated in FRA 2005 (13 million ha) (p. 22 in FAO 2010a).

An interesting statement followed the above citation: "While the deforestation rate for the tropical countries for the 1990s did not change significantly as a result of this additional information, the inclusion of countries in the temperate and boreal zone made a significant difference" (p. 22 in FAO 2010a).

We interpreted the statement that FRA 2010 observed no significant deceleration in the deforestation in the tropics from 1990 to 2010. This was never explicitly visible in the 340 pages of the main report or in the news release of 2010. We may only ask, why this internationally desired news was so well hidden?

FRA 2010 news release of 25 March 2010 launched the following headline news: "World deforestation, mainly the conversion of tropical forests to agricultural land, has decreased over the past 10 years but continues at an alarmingly high rate in many countries, FAO announced today." A typical deforested site has been prepared for shifting cultivation in Photo 5.22.

It is surprising that this piece of news was distributed, while later contrary information was reported as quoted above.

Our main criticism on the quality of FRA 2010 concerns the interpolation and extrapolation methods, which were left for subjective interpretation in the hands of the country reporters. A common scientific modeling should have been applied by the core staff of FRA 2010 in Rome. Only in this way more reliable estimates for the reference years 1990, 2000, 2005 and 2010 had been produced. Especially the estimates for 2010 remained unreliable by the present practice.

The reliability of the 2010 estimates of forest areas and other indicators were instrumental in determining the key findings. The news releases were based on the inferences based on this least reliable reporting year. In general, too much and too unreliable other data were collected and published without explaining the quality of the published data. This must have reduced the time available for compiling the most important forest area, growing stock and carbon stock data.

Photo 5.22 Deforested site used for shifting cultivation in Khao Kho, Thailand (Photo: FAO/ Patrick Durst)

FAO states the primary positive news of the conclusions as follows: “The rate of deforestation is showing signs of slowing down at the global level and significant progress has been made in some countries to reduce the rate of forest loss in the last 5–10 years” (p. 193 in FAO 2010a). It surprisingly omits mention of the actual news that tropical deforestation of natural forests has remained the same at 12 million ha/year. This is possible when FAO applies the “net deforestation” concept and when plantation forests have been expanded, especially outside the tropics and particularly in China.

Surprising changes in global forest area can take place due to new national forest inventories. How global forest area increased by 109 million ha from the report of FRA 2005 to FRA 2010 for the same year of 2005 (FAO 2006, 2010a)?

“This is mainly because Brazil reported an additional 53 million ha of forest as a result of the use of higher resolution remote sensing imagery and both the Democratic Republic of Congo and Mozambique reported more than 20 million ha of additional forest – some of which was no doubt due to a reclassification of land earlier reported as other wooded land. Indonesia reported an additional 9 million ha for 2005 because the earlier estimate was forecasted based on data from 2000 and the annual deforestation rate for the 1990s, while the new estimate utilized the updated figures from 2003 to 2006, which show that the deforestation rate had declined considerably, especially in the period of 2000–2005.” Australia’s forests had also similarly increased by 9 million ha (p. 22 in FAO 2010a).

Box 5.4 Continuous Systematic Sampling-Based National Forest Inventory in Finland (Kari T. Korhonen)

The first National Forest Inventory of Finland (NFI) was executed in 1922–1924. Since then, NFIs have been repeated in cycles of about 10 years. The tenth NFI was launched in 2004 and completed in 2008.

The NFI covers all land and water areas of Finland. In most of the country, the NFI is based on systematic cluster sampling. Only in the most northern, sparsely forested, parts of the country (northern Lapland) is stratified sampling applied. The distance between clusters, the shape of the cluster, number of field plots in a cluster, and distance between plots within a cluster vary in different parts of the country according to spatial variation of forests and density of roads. The sampling designs applied in the tenth NFI were as indicated in Table 5.14.

Table 5.14 The design of systematic cluster sampling in the tenth NFI by geographic districts

Area	Average distance between clusters	Shape of the cluster	Distance between plots in a cluster	No. field plots in a temporary (permanent) cluster
South most Finland	6 × 6 km	L-shaped	250 m	12 (10)
Central Finland	7 × 7 km	Rectangular	300 m	14 (14)
Southern North Finland	7 × 7 km	L-shaped	300 m	15 (11)
Lapland	10 × 10 km	L-shaped	300 m	15 (11)
Northern Lapland[a]		L-shaped	450 m	9 (–)

[a]Stratified sampling: sampled area is first divided into 3 strata according to the percentage of forests. Stratification is based on forest maps produced in previous inventory cycle with the help of satellite imagery

The reason for varying the sampling design in different parts of the country is due to the variation of the forest structure and density of road network. The cluster size and distance between plots have been planned so that one field team can measure one cluster in one working day. For most regions in Finland, the L-shaped clusters have been found effective because they require less walking than line-shaped clusters and the intra-cluster correlation is less than for rectangular clusters.

The data consist of two main categories: stand description and measured tree data. Stand description variables describe the forest stand where the field plot is located. If a field plot is divided into several stands, all stands are described. For tree measurements, the sample plot is a restricted by using a Bitterlich relascope point with a maximum radius of 12.52 m (12.45 m in North Finland). A few variables describing the stand qualities are collected on this area of a sample plot instead of the whole stand.

(continued)

Box 5.4 (continued)

The field plots of the tenth NFI were measured in 2004–2008. Field plots are measured annually in the whole country. Thus, it is possible to estimate the amount of forest resources for each year. In order to reduce the sampling error, data from 2 or 3 years are usually used to achieve an estimate for one year. The potential sampling error in using the full 5 year data for the total volume of growing stock in the whole country has been computed as 0.5% and for the forest area as 0.4%. The potential sampling errors of the respective change estimates are about two times of the previous estimates.

The data can be grouped in following categories.

Stand data

- Administrative data: owner group, restrictions for forestry, etc.
- Site description: land use class (both national and FAO definitions), main forest type, site productivity class, soil type, soil texture etc. Growing stock: crown storeys, species composition, crown cover, development class, age, mean height, damages, etc.
- Accomplished and proposed measures: accomplished and proposed cuttings, silvicultural measures, soil scarification, draining.

Tree data

- Tally tree data: diameter, species, quality class, crown class
- Sample tree data: height, diameter at 6 m height, age, increment, etc.
- Dead tree data, only on permanent plots

The estimation consists of the following steps:

1. Estimation of volumes by timber assortments for sample trees.
2. Generalization of volumes for tally trees.
3. Summary of stratum wise area and volume statistics.

Sample tree volumes are estimated with general volume functions and taper curve models (for volumes by timber assortments) using d, d_6, and h as regressors (d=diameter at 1.3 m, d_6=diameter at 6 m, h=height of trees). Volume estimates are generalized for tally trees with non-parametric k-nearest neighbor methods. In this method, each tally tree gets its volume estimate from a sample tree most similar to it. Similarity is measured with tree species, breast height diameter, geographic location, and site class.

The area represented by a sample point is estimated by dividing the land area by number of sample points in each of the 13 provincial Forestry Centers. The land area is taken from the official statistics maintained by National Land Survey of Finland. The area estimate for an arbitrary stratum is simply the sum of the areas represented by the sample points. If a sample plot is divided into several stands, only the stand where the plot center hit is taken into account.

(continued)

Box 5.4 (continued)

Photo 5.23 A typical object of NFI in Finland. A forest stand of mixed pine (*Pinus sylvestris*) and birch (*Betula pubescens*) in a forest holding in Toholampi, Finland, 64° of northern latitude. Trees of natural regeneration after drainage of a peatland, about 50 years old. Capercaillie (*Tetrao urogallus*) in the foreground. Observations on biodiversity have been attached at NFI since 1952 (Photo: Matti Palo)

For each tree, sampling probability at the plot is known. The total volume estimates for an arbitrary stratum are obtained by summing the tree wise volume estimates multiplied by the inverse of the sampling probability and area estimate of the stratum.

Country and district level results are estimated using only the field data. Combining the field data with map data and satellite images it is possible to estimate reliable forest data also for smaller areas, even at a level of a forest holding (Photo 5.23).

5.6.7 Discussion and Conclusion

Mahapatra and Kant (2005) provide one of the few exceptions among the deforestation modelers in their critical attitude to the quality of data used in their deforestation modeling. After some discussion about the alternative data sources they adopted

a three class grouping of countries in the relative pace of deforestation based on FAO 1990 assessment. This qualitative dependent variable was assumed to address the problem of poor quality of data, which was not true. Their expertise in assessing different forest data sources was also flawed concerning the difference between FAO Production Yearbook and the periodic assessments by the Forestry Department of FAO.

FAO (2006, 2010a) never gave clear explicit warning of the declining quality of the reported data from forest areas via growing stock to biomass and carbon stocks. Forest area in a certain year represents the basic observation. Growing stock of living or dead trees is often derived from the area data by applying reference multipliers from neighboring countries or certain non-representative experimental plots. In order to transform the growing stock data into biomasses new similar multipliers are needed. Carbon stocks remain the least reliable "guesstimates" due to new transformations by average multipliers.

Another missing quality warning by FAO (2006, 2010a) concerns the change estimates of forest areas, growing stock, biomass, and carbon stocks. It is not disclosed to readers that the change estimates are much more unreliable than the stock estimates of one year. Russia, Canada, Brazil, and most of the developing countries cannot make any reliable change estimates. Kauppi et al. (2006) got global media attention with their news about returning forests but the authors forgot to give any reservations on the inferior quality of their data (FAO 2005) in either of these two respects.

FRA 1990 (FAO 1993b) applied a quality of data assessment in three classes (1, 2, 3). We used this information by giving more weight to the higher quality data. This practice improved our modeling outcomes. FRA 2005 made Table 5.2–5.5 to inform the readers about the quality of the data (FAO 2006). It asked every country whether the most recent data on forest area was produced by field survey/mapping, remote sensing, or expert estimate. Further questions concerned forest area time series, forest area projection, growing stock time series, and biomass estimation. We could not use this information to improve our modeling. FRA 2010 had dropped any assessment of the quality of county-wise data in the main report (FAO 2010a).

My first major proposal concerns the scientists who are active in deforestation and forest transition studies. They should resume the standard scientific practices to critically evaluate the validity and reliability of the empirical forest-related and other data they apply in their analyses and model developments. Even such a big organization as FAO is producing data and statistics with big quality variation.

My second major proposal inherent in this analysis is that the world has an imperative to improve the quality of the global, regional, and national forest resources assessments. The proposal is in line with the 1992 statement 2c by the "Forest Principles" of the United Nations Conference on Environment and Development: "The provision of timely, reliable and accurate information on forests and forest ecosystems is essential for public understanding and informed decision-making and should be ensured" (United Nations 1992).

Russia, Brazil, and Canada jointly own 41% of the world's forest area. For FRA 2010 the three leading forest countries were not able to objectively detect the change in their vast forest areas. The global community should put pressure on these countries

to develop their national inventory methods to match the actual global reporting requirements. A high number of other countries are also missing relevant systems in this front. “FAO estimates that only 15% of the world’s developing countries actually carry out regular field-based forest inventories” (Tomppo and Andersson 2008).

The idea of improving the inventory methods was also supported by Marzoli (2001) and Matthews (2001). Some development in the inventory methods as initiated by FAO has been lately going on (Tomppo and Andersson 2008; Tomppo et al. 2010). The actual global REDD+ initiative (Angelsen 2009) should set as a priority the improvement of the quality of the forest resources data. Otherwise, its implementation will be a failure. Improved monitoring systems would also provide an instrument against corruption (Sect. 5.1).

Finally, a case of approximate costs of maintaining an up-to-date monitoring system is here introduced from Finland (Box 5.4). It has a continuous national monitoring system of forest resources, which presently is managed with about EUR 2 million annual budget. The whole country is covered annually but the target reliability at the level of 13 subnational units is attained in 5 years. Accordingly, the total budget for one full 5-year round of this multiple-source national forest monitoring is about EUR 10 million. It covers ground sampling, remote sensing, sourcing data from the National Land Survey, processing of data, and publishing the findings. The labor input comprises 18 man-years by technical staff and 13 man-years by researchers or as a sum for one year a total of 31 man-years and for the 5-year round 155 man-years (communication by Kari T. Korhonen, Metla, 2 May 2011).

The situation in the uses of forest data in deforestation and forest transition studies reminds me of life in the Wild West of the United States during the early frontier days!

> By the proper use and interpretation of data it is possible by such methods to produce meaningful results if, and only if, the basic conditions for the realization of those results are inherent in the data. (p. 16 in Reichmann 1981)

5.7 Failures in Global Forest Politics

5.7.1 Introduction

The aim of this section is to describe the evolution of globalization of forest politics and analyze the effectiveness of the various global formal and informal institutions focused to decelerate tropical deforestation.

There is a difference between the terms “politics” and “policy.” Politics can be briefly defined as the science and art of government dealing with the form, organization, and administration of a state or a part of one, and with regulation of its relations with other states (Tansey 2000). “Policy” has been defined as “a definite course or method of action selected from among alternatives and in light of given conditions to guide and determine present and future decisions” (Webster 1989).

In global forest politics we are interested both in procedural and substantive issues. The evaluation of global forest politics is executed here by trying to identify

Box 5.5 A List of Initiatives by International Forest Politics 1700–1945

- International wars and colonization for timber hunt by Britain, France, Germany, USA, Italy, Japan, Russia, Netherlands, and Belgium in particular
- Transfers of German forestry paradigm to Russia, Denmark, India, Japan, Norway, Sweden, Finland, USA, Canada, etc.
- Exchanges of students and teachers, other consultancies, research findings, and textbooks
- 1892 IUFRO was established among the German speaking nations
- 1926 World Forestry Congress I in Rome
- 1932 Timber trade meeting of experts in Geneva by the League of Nations
- 1932 Comité International du Bois (CIB) was established in Vienna
- 1935 in Copenhagen and 1936 in Helsinki: Convention of the European Timber Exporters
- 1936 World Forestry Congress II in Budapest
- 1939 in Berlin: Centre International de Sylviculture (CIS)

how far the objectives of the global players have been achieved. We call this performance indicator as "effectiveness." In politics both cooperation and competition may involve bargaining, argument, coercion, and lobbying. The potential for alliances has been a key to success in the art of politics. Conflict and consensus are key concepts in policy formulation (Tansey 2000).

Both formal and informal global institutions (Sect. 2.4) are described here. The governments, intergovernmental organizations (IGOs), transnational corporations, and non-governmental organizations (NGOs) have been the major players in the various arenas of global forest politics. They have actively been setting agendas for global forest politics.

Surprisingly many international initiatives were launched already before the World War II (Box 5.5). Their scope, however, was hardly global and their impacts on national forest politics or forests remained weak. Since 1945 FAO was for a couple of decades nearly the only actor in global forest politics. Since the early 1970s the number of global actors has surprisingly increased. FAO has largely remained in a shadow of many other more dynamic global players.

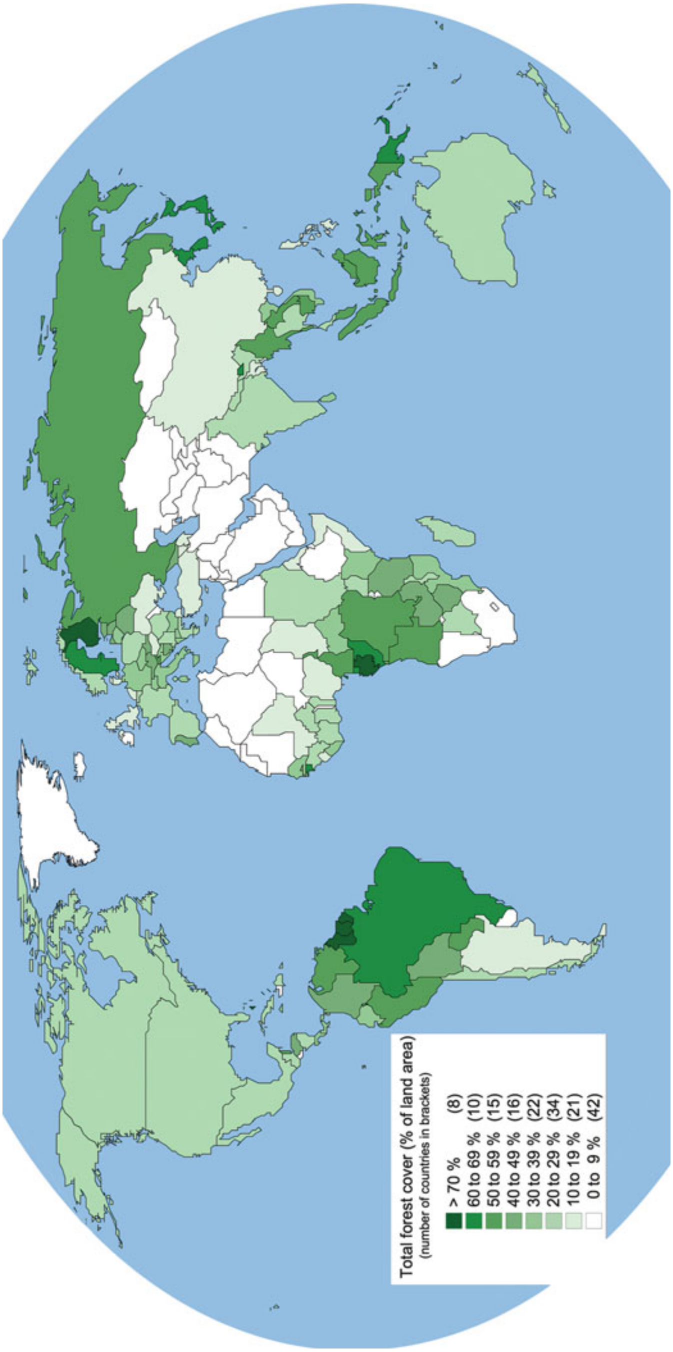
We described the scale and tough continuity of tropical deforestation in Sects. 5.1, 5.2, and 5.4. Tropical natural forests (Photo 5.24) have been deforested by about 12 million ha/a during 1990–2010 (Sect. 5.6). Largest "net deforestation" in the whole world during 2000–2010 has taken place in Brazil, Australia, Indonesia (Photo 5.25), Nigeria, Tanzania, Zimbabwe, D.R. Congo, Myanmar, Bolivia, and Venezuela. (FAO 2010a)

There is a clear spatial difference between the concepts "international" and "global." The former may as a minimum occur only between two countries, while

Photo 5.24 Tropical rainforest next to Balikpapan, Kalimantan, Indonesia, in 1996 (Photo: Erkki Lehto)

Photo 5.25 Agriculture is expanding and forests retiring between Balikpapan and Banjarmasin, Kalimantan, Indonesia in 1996 (Photo: Erkki Lehto)

the latter refers to worldwide activity (Map 5.4. Four tropical countries visible in this map, Guyana, Suriname, French Guiana and Gabon, have more than 70% forest cover. Finland is the only country in this category lying outside the tropics). A substantial difference between the two concepts has been expressed as follows: "…the



Map 5.4 A global sphere: total forest cover as a percentage of total land area in 168 countries in 2000 (by Erkki Lehto; Data source: FAO (2005))

international realm is a patchwork of bordered countries, while the global sphere is a web of trans-border networks" (p. 15 in Scholte 2001).

Global forest politics since the 1970s has primarily aimed at decelerating tropical deforestation and forest degradation. Global forest politics and environmental politics have been closely interwoven due to a number of environmental impacts of deforestation on biodiversity, climate change, desertification, watersheds, and erosion. The intimate relationship by indigenous peoples and poverty with tropical forests have also brought into the arena of forest politics social issues, human rights, and cultural and spiritual aspects with traditional knowledge and immaterial property rights.

Next we shall start reviewing global forest politics by focusing on the policies by FAO.

5.7.2 Formal Global Forest Politics by FAO, 1945–1983

If globalization is tentatively defined as a worldwide activity, then the first clear step toward globalization of forestry and forest politics took place in 1945 with the establishment of the Food and Agricultural Organization of the United Nations (FAO). It was vested with the global mandate of forestry issues. FAO made its first attempt to assess global forest resources in 1948. It soon started to organize World Forest Congresses, like the one in Helsinki in 1949 (FAO 1949).

"There has been and still is considerable discussion regarding the proper role of FAO and its Division of Forestry and Forest Products with relation to these questions. FAO's primary function is to provide the machinery through which its member nations can consult and work together toward the achievement of the proper balance between production and needs for forest products" (p. 32 in FAO 1949, part 2).

FAO continued running world forestry congresses by 5-year intervals in different parts of the world with recommendations and resolutions. The concept of progressive forestry was launched in 1949 by the Helsinki congress, and the concept of multiple use forestry in 1960 by the Seattle congress. However, no instrument was created for their implementation and follow-up. Also periodic global forest assessments were organized. Similarly, FAO mobilized periodic timber trend studies covering demand for and supply of forest products as well as annual forestry production and trade statistics.

FAO (1958) published an interesting early forest policy paper. It brought up the prospect of likely expansion of demands for forest products by forest industries in developing countries. The paper discussed widely the potential deforestation impacts of this expansion. It also reminded that industrialists have acted as timber miners in the past and especially so in North America, which was considered "gloomy enough" in the United States.

"The foregoing pages have stressed the new spirit that is aboard today and the reasons why one may hope that lessons have been learned from the errors of the past, and that the impact of the forest industries on forests in the future is likely to

be more beneficent than destructive" (p. 33 in FAO 1958). It was believed that the rise in "forest consciousness" and in "understanding the multiple role of the forest both by the government and by the man in the street in developing countries would prevent this kind of adverse practice" (p. 75 in FAO 1958).

Then FAO published the classic paper "Role of Forest Industries in the Attack on Economic Underdevelopment" by Jack Westoby (1962). He was the chief of the Forest Economics Branch of the FAO Forestry and Forest Products Division. Westoby did not use any explicit theory concept in his eminent paper but it was clearly a theoretical breakthrough in comparison with the earlier practice (e.g., FAO 1958).

Westoby (1962) specified the multiplier effects of forward and backward linkages of forest industries higher than an average among all the industries. Therefore, expansion in forest industries could propel economic development. No deforestation risk was mentioned by him although expansion of industrial logging was a part of his construct. Also fuelwood was excluded from his thesis. Westoby's paradigm was well received and FAO followed it for a couple of decades in its forest policies (Sect. 2.6).

Step by step since 1960 along with external funding options FAO adopted forestry development projects of various kinds in a number of developing countries (Boxes 5.2, 5.6 and 5.7). The three projects described in the boxes were following the Westobyan paradigm of forest-based industrial development. The projects

Box 5.6 In Support of Forest-Based Development: Forestry and Forest Industries Development Field Project by FAO in Peninsular Malaysia (Palo 1975)

My first visit to a tropical country was in 1975. I consulted a FAO/UNDP project on forestry and forest industry development in Malaysia. It covered the eleven states in Malay Peninsula and excluded Sabah and Sarawak states 2,000 km away in Borneo Island. The project aimed to establish a strategy for sustaining the remaining natural forests, which had been increasingly cleared for rubber tree and for oil palm plantations. The project manager was Kenneth Sargent, a forester from UK.

A national inventory of forest resources was an important component of this project. The systematic sampling-based inventory was the first time in the history of Malaysia. It was so well designed that it established a baseline for the future inventories. The main challenge of the project was to develop a linear programming-based forest sector-planning model for integrated sustainable forestry and optimal clearing of natural forests to rubber and oil palm. It was a globally pioneering undertaking in those days and received international reputation. The main project had about a dozen experts from different fields and countries and about same number of short-term consultants.

My mission was to develop forest sector statistics in the eleven states of Peninsular Malaysia. I visited all the states in the peninsula and got my

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Box 5.6 (continued)

personal experience on the consequences of low stumpage price system, when clearing for other land uses was more profitable than sustainable forestry. However, rubber plantations after all were based on exotic rubber trees imported via Kew Garden in England from Brazilian Amazonia. Then rubber wood had no market and after a rotation of about 27 years the trunks were burned on site.

Later on, first a minor market appeared as chips for paperboard production in Japan. During an excursion to Malaka by the 2000 IUFRO World Congress in Kuala Lumpur we learned that flourishing markets for rubber wood had been created by furniture industry. The supply of natural rainforest timber had then nearly disappeared from the Peninsula. Even oil palm trunks have some uses in replacing lumber. Already during my consultancy Malaysia differed from the Philippines in the respect of timber harvesting systems. While the latter relied on heavy imported machinery from the United States, the former developed their domestic solutions in the machinery.

The domestic Chinese businessmen also established sawmills, veneer mills and plywood mills for domestic consumption and flourishing exports. Malaysia has remained a major exporter especially in wood-based panels but also in sawnwood and Sabah and Sarawak in roundwood (FAO 2009). Forest tenure in Malaysia rests with individual states. Deforestation still continues in those two largest states but agriculture and other development has been mostly on sustainable basis.

Clearing of forests has favored sustainable plantations of rubber tree and oil palm. Along with tin, oil, and other industrialization and under long-time stable political system Malaysia has been able to alleviate poverty and further its development more than most of the tropical countries. Especially in comparison with the Philippines, which used to be the most promising Asian developing country in the 1960s, Malaysia has succeeded in a superior way. Indonesia is much richer in timber and other natural resources than Malaysia but politically unstable and has remained at much lower development level than Malaysia. Malaysia in 2007 had a rank 66 in Human Development Index, the Philippines 105, and Indonesia 111 among 182 countries (UNDP 2009; Palo 1988).

Box 5.7 In Support of Forest-Based Development: Forestry and Forest Industry Development Field Project in Mozambique by FAO (Palo 1978)

In 1978 I consulted FAO project “Forestry and Forest Industry Development” in Mozambique. This project was financed by UNDP and executed by FAO. The main objective was to support the government policy for integrated forest

(continued)

Box 5.7 (continued)

sector development in Mozambique. It is interesting from this retrospective angle that the project still relied on the Westobyan paradigm (Sect. 2.6).

The project also coordinated two subprojects financed by the Scandinavian countries. One was "Manica Afforestation Project" and another "Maputo Fuelwood Project." The Project Manager Jaime Tojá, a silviculturalist from Chile, was then supported by one associate expert, and later on experts in forest industries, forest economics, forest inventory, forest management, forest utilization and training, sawmilling, forestry extension, and five more associate experts were expected to join the main project.

Already short-term consultants on forest industries, silviculture, forest policy, and forestry education had visited and supported the main project. My terms of reference focused on forest information system development. The two sub-projects employed five professional foresters. They had already started nursery production as well as designing and clearing for new plantation forest sites. The two projects employed about 600 local workers.

I prepared in one month a report on the role of forest sector statistics, the statistical situation, the requirements for information, and lastly a number of recommendations for the development of the forest sector information system. I made one fact-finding tour to Manica province in the northeast and visited several offices and sawmills in Maputo.

With my guide we visited a nursery and a sawmill close to the then South Rhodesian border. After only half a year Pekka Pesonen returned from Mozambique and told me that the helicopters of the white Rhodesian army had occasionally arrived to the territories of Mozambique and fired all local people around including consultants.

I had to use an interpreter, when I did not master Portuguese. National independence in Mozambique was only three years old. The Portuguese experts had left the country. Therefore, Mozambique was missing both foresters and forestry organizations. The absence of local counterparts and the escalating civil war around 1980 may have undermined the *de facto* success of these projects.

Unfortunately, corruption has also arrived. In 2009 Mozambique had a rank of 130 from the least corrupted country among 180 countries (Transparency International 2010). Accordingly, under socialistic forestry (Sect. 5.1) deforestation has continued (FAO 2006). I am not aware of the later forestry projects but I can deduce that sustainable forestry is still only a distant dream in Mozambique.

represent *de facto* impacts of *de jure* policies explained above. Field projects have been the instruments by which FAO has tried to turn its policies into *de facto* sustainable forestry practices in its member countries.

Professor N.A. Osara, a Finnish forest economist and the new Director of FAO's Forestry and Forest Products Division, described the comparative advantages the

developing countries might have in plantation forests by providing raw material for large-scale pulp mills: "…no other conclusion can be drawn but that the tropics are bound to play an ever increasing role in the world's wood and fiber supply" (p. 119 in Osara 1963).

Dr. Alf Leslie (1968, 1971), an Australian forest economist by birth, who later served FAO as the Chief of the Forest Products Division of FAO, expressed his belief in the potential of tropical forestry for economic development. "The exploitation of tropical forest for export log market is likely to have greater effect on development in the receiving country than in the exporting country. An export log trade may have short term advantages for a developing country, but the opportunity cost in terms of long term multiplier and linkage effects could be far too high" (p. 71 in Leslie 1968).

While Westoby (1962) excluded fuelwood from his analysis of forest-based development, Earl (1975) made an original contribution in his "Forest Energy and Economic Development" about the potential roles of fuelwood and rural populations in economic development. He argued that a key to successful development is the promotion of viable rural economy. Enough fuelwood has to be provided for the basic needs of the rural people. Earl's book had no FAO connection but the reference is included here due to its assumed effect on the transformation of FAO's forest policies.

Another benchmark for policy reorientation was launched by Westoby (1978) himself, then a retired FAO officer. He stated that forest industries had made only little or no contribution at all to economic development in the underdeveloped world. His earlier arguments of prioritizing of forest industries in development seemed then valid enough that it was followed by FAO in promoting such projects. The production of tropical hardwood logs by forest industries expanded from 3 million m^3 in 1950 to 49 million m^3 in 1976, but simultaneously the domestically processed proportion of logs declined.

Westoby (p. 7 in 1978) continued that now every underdeveloped country has a forest service. Nearly all of these forest services are understaffed and miserably underpaid. "Because they exist, exploitation is facilitated; because they are weak, exploitation is not controlled. Because exploitation is uncontrolled and management non-existent, marginal farmers, shifting cultivators, and landless poor have followed in the wake of loggers, completing the forest destruction. Of the original moist forest area, over half has disappeared in Africa, over one third in Latin America, and over two fifths in Asia. And the tropical forests continue to shrink" (Sommer 1976) (cf. Sect. 5.1).

Westoby (1978), in the FAO's World Forestry Congress in Jakarta, argued further that, due to the concentration of development efforts on industrial activities, the supporting of agriculture and raising rural welfare have been either badly neglected or completely ignored. He pointed out that the real problem lies in the fact that, in many underdeveloped countries, neither government nor officialdom displayed any great enthusiasm for mitigating the lot of the rural poor.

Westoby's (1978) view was supported by Leslie (1980), who observed that only a few areas in the developing world have been identified for which a positive general economic development can be explained to any marked degree by forest-based

development. The transformation of the development paradigm was also visible among the field projects (Box 5.8).

Accordingly, FAO transited from export-led or import substituting forest industrialization paradigm toward community and social forestry in the latter part of the 1970s and in the 1980s following the example of the World Bank (FAO 1979, 1980).

Box 5.8 In Support of Human Capital: Development of Forest Management Capability in Nigeria by FAO (Palo and Olojede 1982)

I worked in Nigeria in 1981–1982 consulting a FAO project on "Development of Forest Management Capability." The project manager was Jim Ball, a forester from UK. The project's mission was to promote the human capacity in forest management. The revolution of the development paradigm is visible in the title and contents of this project. No more forest-based development but rather in support of human capital development (Sect. 5.7.2).

FAO as an executive body and UNDP as a financer had since the early 1960s been active in Nigeria. Since then they had jointly run a number of projects, such as establishment of a School of Forestry at the University of Ibadan, and savanna forest research station, technical promotion of forest management, forestry development, arid zone afforestation, school for forestry mechanization, fire protection, erosion control, wildlife training school, forestry data processing, and technical services in forestry cartography. FAO jointly with Finland also established a sawmilling training school.

FAO and UNDP had jointly drafted a plan of future priority projects as follows: development of forest planning and management capability, arid zone forestry program, sawmilling and forest utilization center, federal school of wildlife management, forest mechanization training center, support to the School of Forestry, University of Ibadan, development of freshwater swamp and mangrove forests, and strengthening of the Forest Research Institute of Nigeria.

My consultancy of three months aimed for development of the statistical information system in the Nigerian forest sector. I had two Nigerian counterparts. Both of them were capable professionals – one a forester and the other a computer man. I wrote the report jointly with A. Olojede, the forester. In this way there was initially hope for continued support of development of forestry statistics.

However, both my counterparts soon moved out of the Federal Department of Forestry. Since the early 1980s Nigeria, in spite of rich oil fields and some other natural resources or due to them, has remained one of the most corrupted countries in the world and has lagged in development. Its rank in the Corruption Perceptions Index was 130 out of 180 countries. Human

(continued)

Box 5.8 (continued)

Development Index in 2007 was 158 among 182 countries (Transparency International 2010; UNDP 2009).

Accordingly, under the individual state ownership of all forests Nigeria has practiced socialistic forestry along with rampant corruption and deforestation (Sect. 5.1; FAO 2006). Under such conditions with missing law and order hardly any positive impacts of the numerous early development projects have become realized. I was surprised to discover a number of same underlying factors in deforestation in ecologically, economically, and culturally so different countries as Nigeria and the Philippines (Box 5.2). My mission in Nigeria confirmed my motivation to study underlying causes of deforestation, which I mobilized immediately after I had returned home.

Even environmental considerations won ground and the first assessment of tropical deforestation was executed a few years earlier (Sommer 1976). Also such themes as watershed management, upstream conservation, and conservation in arid and semi-arid zones were analyzed (Palo 1988).

An integrated policy outline was later presented by FAO under the heading "Forestry for Development": "The forest of the tropics possesses the potential to make a major contribution to development meeting the basic needs of the rural poor, sustaining industries which provide employment and income, and maintaining the environmental stability needed for the continuing production of food. But if this potential is to be realized, uncontrolled exploitation of the forest must be replaced by management of entire forest resource" (p. 3 in FAO 1983).

The mission of community and social forestry was to attack economic underdevelopment and poverty via a bottom-up strategy rather that the earlier top-down idea of forest-based industrialization (Westoby 1962). But so far we have not seen any worthwhile alleviation of poverty via community and social forestry. Why? Maybe a relevant integrated theory and effective governance are missing and corruption prevailing. Poverty alleviation on a large scale by forests may remain only as rhetoric without national transformation of policies and its enforcement (Palo 2004).

De facto execution of the *de jure* policies via field projects has never been an easy exercise, while the governments have often been corrupted and not motivated to stop deforestation. Persson supports this in the following way: "Corruption, collusion and nepotism are often serious problems in forestry. They make it very difficult to achieve 'organized forestry.' There are always strong forces working for the liquidation of forest capital as quickly as possible" (p. 40 in Persson 2003).

A conclusion of the impacts of FAO forest politics during 1945–1983 may be expressed as follows. The past effectiveness of FAO in order to halt deforestation has been duly criticized (Humphreys 1996). FAO has had perhaps too strong dependency on its national member governments in the annual strategy meetings and a

subsequent dependency on consensual decision-making (Saastamoinen 2009). FAO lost its leading role in global forest politics in the early 1980s to other formal United Nations' bodies and to a few informal global non-governmental organizations. UNEP, IUCN, and WWF launched a World Conservation Strategy in 1980. ITTO was established in 1984. World Resources Institute, the World Bank, and UNDP mobilized the TFAP project with major funding also in 1984.

Since 1945 until the early 1980s FAO acted primarily as a global clearance office for forestry statistics gathering, analyzing, integrating, and publishing but without global political vision, will, and enforcement capacity. However, a number of field projects with varying effectiveness became implemented (Boxes 5.6, 5.7, and 5.8).

The purpose of the rest of this section is to identify the emergence and evolution of the subsequent global forest politics based on worldwide environmental issues. We shall next introduce the emergence of global environmental politics on forests.

5.7.3 Emergence of Environmentalism, 1961–1983

Conservation of nature and animals has its historical roots in the nineteenth century. The birth of modern environmentalism can be traced to the early 1960s.

The World Wildlife Fund (WWF) was established in London in 1961. Later on the name was changed into World Wide Fund for Nature. A number of prominent people joined this NGO. A large trust fund was soon created. After that headquarters with competent staff was established at Gland in Switzerland next to the Headquarters of IUCN, with which WWF has had close collaboration. WWF grew in the 1970s and 1980s into a global lobbying body in support of sustainable development of forests and other natural resources.

Rachel Carson (1962) wrote her book "Silent Spring" to demonstrate the devastating impacts of DDT, other pesticides, and herbicides on birds, fish, and human health. The book was based on systematically documented facts. It was also well written. Therefore, it soon became a bestseller and influential in raising the green movement all over the world.

The Club of Rome was established in 1968 in Rome by an Italian industrialist Aurelio Peccei and a Scottish scientist Alexander King with a small number of prominent individuals from fields of diplomacy, industry, academia, and civil society. They all were worried about unlimited resource consumption in increasingly interdependent world. The participants promised to spend next year in raising awareness of the world leaders about these issues. One aim was to apply systems thinking in increasing understanding of these long-range worries (Club of Rome 2010).

I spent the academic year 1969–1970 as a visiting scholar at the University of California Berkeley. Then I first time learned about the ongoing climate change, consequent melting of polar glaciers with rising surface of ocean waters at a lecture by a professor of electricity.

Another professor, Arnold Schultz of systematic forest ecology in Berkeley, became most popular lecturer in the whole campus with his application of general systems theory to the analysis of forest ecosystems. Ecology as a scientific discipline was then

a young field created largely only since the 1950s, although the concept of ecosystem was launched already during the 1930s (Palo 1971). This appearance and development of ecology was important for identifying various global environmental issues. However Schultz differentiated his discourse "ecosystemology" from standard ecology.

The concept of forest during my undergraduate forestry studies at the University of Helsinki around 1960 was defined by my professors as the growing stock of trees with the respective soil. After an ecological paradigm shift forest was viewed as an ecosystem, where trees were interacting with other living organs and their physical environment (Palo 1971). The green movement was visible in the campus of Berkeley in a high popularity of these lectures and also in many other ways.

Greenpeace was established as an NGO in 1971 in Vancouver, British Columbia, Canada. In 1979 it was merged with Greenpeace International with a global mission on conservation of resources. Since then Greenpeace has grown with its increasing financial resources, staff, and millions of supporters as well as its own navy and air force to be able to strike globally on strategic points. Lobbying to conserve forests has been in its agenda as one of the major activities.

Greenpeace used to concentrate on big global issues. For example, in 1992 the whales were a global focus. The next year, 1993, forests became the focus of its campaigns. Finland organized the meeting of European Forest Ministers in June at the Finlandia congress center. Greenpeace activists arrived on the roof of the building and rolled down a banner against logging of old growth forests in Finland. Helsingin Sanomat, the leading daily paper in Finland, published next morning a full-page photo of this banner. Greenpeace was also able to lobby Der Spiegel of Germany to publish a lengthy story of forest destruction in Finland (communication by Risto Seppälä).

Greenpeace and WWF provide cases of NGOs that have been able to gather enough financial resources and supporters in order to become effective lobbers in global, international, and national forest politics and business. Their activities had not been so successful without dramatic change in information technology and strong support of media.

First, the fax machine appeared in the early 1970s, then personal computers in the 1980s, and finally Internet, e-mail and mobile phone in the 1990s. This new technology has allowed information flows in real time and simultaneous global campaigns. Increasing knowledge in ecology with a fresh concept of biological diversity and new global environmental threats, such as deforestation, desertification, and climate change have also contributed to the surprising political and economic powers created from nothing by these global NGOs.

The United Nations organized a conference on the Human Environment in 1972 in Stockholm with minor forestry issues. I participated in a preparatory meeting some months earlier at the University of Jyväskylä for Finland's contribution in Stockholm. The Stockholm Conference established the environment as an issue on global development agenda.

The United Nations Environment Program (UNEP) for global coordination of environmental politics was established in the Stockholm Conference. UNEP played a leading role in global environmental activities after the Stockholm Conference.

A wide participation of environmental NGOs opened the access for their further intensified participation in global environmental activities (Holmgren 2008).

Soon after Stockholm, United Nations Educational, Scientific and Cultural Organization (UNESCO) launched its "Man and the Biosphere Program," which has been implemented in numerous countries and survived since then. Also FAO produced a few interim studies on tropical deforestation. UNEP catalyzed FAO jointly to implement an integrated assessment of forest resources and deforestation in 76 tropical countries (Lanly 1982).

UNESCO, UNEP, and FAO (1978) jointly edited and published a massive handbook on "Tropical Forest Ecosystems. A State of Knowledge Report." It gave an in-depth description of tropical forest ecosystems and paved the way to this new concept of forest. The book also gave an identity to 200–300 million forest people living in and around the tropical forests. They obtained their subsistence mainly by shifting cultivation, hunting, fishing, and gathering. The vulnerability of forest people to deforestation was vividly illustrated. Also the erosion sensitivity of tropical soils after deforestation and the gloomy consequences of erosion were demonstrated.

However, after all these efforts, the management of natural, mixed, moist tropical forest according to proper silvicultural and economic regimes remained to a great extent open. The application of sustained yield forestry and natural regeneration were particularly under dispute. The replacement of natural tropical forests by plantations was widely recommended (Palo 1988).

UNESCO jointly with a number of environmental NGOs established the present International Union for Conservation of Nature (IUCN) already in 1948. IUCN's mission is to influence, encourage, and assist societies throughout the world to conserve the integrity and diversity of nature and to ensure that any use of natural resources is equitable and ecologically sustainable. It took, however, some decades before IUCN became an effective political lobber. IUCN is considered as a hybrid body with both governments and NGOs as its members.

In 1972–1975 IUCN mobilized with UNESCO three global conventions: Protection of World Cultural and Natural Heritage, International Trade of Endangered Species of Flora and Fauna (CITES) and Wetlands of International Importance (Ramsar Convention). All these conventions also cover to some extent forestry. This was a take-off of creating of global conventions for conservation of nature.

The Club of Rome commissioned a group of systems scientists from Massachusetts Institute of Technology to produce long-term global scenarios on resource scarcity. A book titled "The Limits to Growth" was eventually published (Meadows et al. 1972). The main message of this team was that there were visible limits to the accessibility of all kinds of natural resources, especially to the non-renewable ones.

Organization of the Petroleum Exporting Countries (OPEC), the oil cartel of the leading twelve oil producers, initiated a global four-fold increase in oil prices in 1973. It alarmed the oil consuming countries that the epoch of cheap oil was over and shook a high number of national economies. This undertaking was like a proof for the findings of "The Limits to Growth."

However, this book was strongly criticized by a number of economists. The critics pointed out that the authors had neglected new options created by increasing prices

and consequent technological change (Douglas and Simula 2010). However, the book with its findings was supported by the Club of Rome and received a wide publicity with the sales of 14 million copies and consequently a strong impact on world leaders (Club of Rome 2010).

UNEP jointly with IUCN and WWF launched a World Conservation Strategy in 1980 with an ethical view on environment and development. It became a document of strong impact on global politics at large and inspired many further campaigns on sustainable development, such as the Brundtland Report (WCED 1987).

The UN General Assembly passed a resolution in 1983, which lead to the establishment of the World Commission on Environment and Development chaired by Gro Harlem Brundtland, the previous Prime Minister of Norway. The Commission defined sustainable development as development that meets the needs of the present without compromising the ability of future generations to meet their own needs. This report and definition became a most significant expression to elevate environment to global political agenda, to link development and environment together and as a guidance for achieving environmentally sustainable development. (WCED 1987)

Next we shall review the evolution and effectiveness of ITTO.

5.7.4 International Tropical Timber Organization (ITTO)

The United Nations Conference on Trade and Development (UNCTAD) was established by the UN General Assembly in 1964 to deal with international trade and development issues. It was active in promoting systems of international buffering stocks of raw materials to balance their highly volatile prices for the benefits of developing producing countries. UNCTAD brought up the idea of Tropical Timber Agreement first time in 1977. The respective Tropical Timber Agreement was formulated and agreed to after lengthy negotiations in 1983.

The agreement was prepared by 36 producing countries and 34 consuming countries as well as a number of intergovernmental organizations (IGOs) and NGOs. IUCN acted as a proponent supported by NGOs in changing the wording in favor of sustainable development by reminding the symbiotic relationship between conservation and development.

Among the objectives of the agreement were the following:

- To provide a framework of cooperation and coordination;
- To promote research and development;
- To improve market intelligence;
- To encourage further processing of timber;
- To promote reforestation;
- To support marketing and distribution of tropical timber exports.

The two most discussed objectives were finally introduced:

- To promote expansion and diversification of international trade in tropical timber;

- To encourage the development of national policies aimed at sustainable utilization and conservation of tropical forests and their genetic resources, and at maintaining the ecological balance in the regions concerned.

The International Tropical Timber Organization (ITTO) was established in 1985 and started its operations by 1986. ITTO had 23 producer countries and 27 consuming countries as its members. Yokohama in Japan was voted as the location of the ITTO Headquarters.

ITTO established in 1990 an ambitious strategy titled as a "Target 2000" (later "Objective 2000") in order to arrive in 2000 at a situation where all the tropical timber came from sustainably managed forests. Only 5% of this target was finally realized, which was a highly ineffective outcome. On the other hand, ITTO was the first international body to publish "Criteria and Indicators to SFM" in 1992, which has some merit to it (Humphreys 1996). However, this was just a *de jure* achievement – *de facto* effectiveness remained modest.

The contents of the Tropical Timber Agreement were renegotiated in 1994 and 2006 without changing too much of its basic message. The mission of ITTO was defined in its 2006 agreement as follows: "…to promote the expansion and diversification of international trade in tropical timber from sustainably managed and legally harvested forests and to promote the sustainable management of tropical timber producing forests" (ITTO 2010a).

However, ITTO has been ineffective in this area, partly due to the regulations of WTO and partly due to diverging views of the producing and consuming member countries (Douglas and Simula 2010).

As a conclusion, ITTO has had a scholarship program for students of tropical producer countries, studies and statistics compilations on tropical forestry and timber trade, and a number of field projects. It is utmost cumbersome to achieve lasting improvements by field projects as described by the experiences in the Democratic Republic of Congo (Box 5.9). ITTO runs the quarterly journal, "Tropical Forest Update," which is well edited and contains actual information on events and news at ITTO, member countries and the tropical timber trade.

Box 5.9 Role of International Tropical Timber Organization (ITTO) in Support of Sustainable Forestry in Democratic Republic of Congo (DRC) (Charles Kilawe)

ITTO's mandate is to promote sustainable development through trade, conservation, and best practice forest management (ITTO 2010b). ITTO brings together tropical timber producers and consumers as equal partners in decision making. Currently it has 60 members. One of the ITTO's central aims is to help timber-producing countries combat illegal logging by strengthening their capacity to develop and enforce forest legislation that promotes

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Box 5.9 (continued)

sustainable forest management. ITTO has shown several initiatives and efforts to promote sustainable development in the Democratic Republic of Congo.

Firstly, it collaborates with Convention on International Trade in Endangered Species (CITES). CITES is an intergovernmental agreement with the aim of ensuring that international trade in species of wild animals and plants does not threaten their survival. ITTO and CITES have a long history of collaboration. The Secretariats of ITTO and CITES are collaborating on a project aimed at ensuring that international trade in CITES-listed timber species is consistent with their sustainable management and conservation.

Afrormosia (*Pericopsis elata*), big leaf mahogany (*Swietenia macrophylla*) and ramin (*Gonystylus* spp.) are among the species in the list (CITES 2008). This convention has helped to protect the mahogany of the Congo basin from excess exploitation, also, halt the hunting of wild animals like elephants, monkeys, and chimpanzees!

Secondly, help to promote forest law enforcement: ITTO has initiated a series of case studies on the export and import data of various countries. These studies serve two objectives: shedding light on undocumented trade, and improving statistical reporting on timber in both producing and consuming countries. In addition, ITTO is working with government and non-government partners to undertake a data collection initiative on the forests of three countries in the Congo Basin. This initiative is aimed at improving the enforcement of forest laws in forest concession areas to promote better forest management and the effective conservation of protected areas (ITTO 2010c).

Last but not least, ITTO fight to combat deforestation and degradation: ITTO has many projects to promote sustainable forest management which are part of efforts to minimize illegal practices, particularly at the stage of logging and extraction. ITTO's pioneering contributions to the development of guidelines, principles, and criteria and indicators of sustainable management of tropical forests, as well as its ongoing work on timber certification and its role in forest management planning, are relevant here (ITTO 2010b).

Lastly but not exhaustively, ITTO provides technical assistance on the REDD program: ITTO through its partnership with UN-REDD Program gives technical support for the development of a national forest inventory system in the Democratic Republic of the Congo to evaluate carbon stocks and their changes. This project aims at supporting DRC to develop a credible measurable, reportable and verifiable (MRV) system for REDD (UN-REDD 2009).

Despite all the efforts ITTO has shown to promote sustainable development in DRC, the road to success is still very long. The organization faces several challenges.

Firstly, illegal logging for timber is increasing. Illegal logging has shifted from southern DRC to the northern primary forests that have not known for

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Box 5.9 (continued)

illegal logging before (Howden 2009). It is anticipated that the current road construction in that area will dispose the area for further over-exploitation because of easier access and local market opportunities (Mongabay 2007b).

In 1990, the ITTO set a goal, "Objective 2000," to ensure that the trade in tropical timber comes from sustainably managed forests by 2000. As of June 2006, according to the ITTO's own assessment, less than 5% of tropical forests were under sustainable management (Mongabay 2007a). By its own admission the ITTO is failing, in the 20 years it has been operating, forest degradation and loss due to logging has accelerated in ITTO member countries rather than being brought under control.

Furthermore, forest certification has failed. Forest certification has not been achieved in DRC. The major reasons for failure to get certified are composed of a wide gap between existing management standards and certification requirements, big difference between the present forest management plan and the certification requirement, insufficient demand for certified products globally and weak ability to formulate appropriate forest sector policies and to ensure their effective implementation (Durst et al. 2006). ITTO could have used its ability to formulate management tools and criteria for sustainable management to help DRC certify its forests.

One additional serious issue is an increase of bush meat trade. Despite close collaboration of CITES, ITTO, and other environmental organizations, completely banning of bushmeat sales in Congo and other west African countries has not been achieved. It is reported recently of accelerated hunting of elephant and primates that are only endemic in Congo basin (Carroll 2009).

ITTO could have helped to enforce simple rules like closing the logging road traffic following the timber harvesting, establishing checkpoints to look for illegal bushmeat or ivory, banning logging roads near protected areas, and providing alternative sources of protein (such as fish ponds) to workers in logging camps could have been used to reduce the impact.

Lastly, corruption in forest resources was among the major causes of conflicts and war in DRC for the past decade (Greenpeace 2007). Leaders focused on accumulating wealth for themselves and forgot about the welfare of the local people (Nzongala 2004). This situation has not yet changed today as DRC is reviewing and giving more than 21 million ha new logging concession permits. Loggers are given bigger area than they ask for and without the consultation of local people.

In most cases, logging companies claim to have paid tax for the development programs of local communities but they are yet to be received by local entities for years (Greenpeace 2007). Recently the government of DRC burned 900 permits after discovering there was corruption in giving those or those contracts do not comply with the terms and conditions of the contract (Howden 2009). ITTO could help DRC government to alleviate this big problem by formulating forest management plans and certification and law enforcement.

Otherwise, however, ITTO has not been effective. After a quarter of a century of ITTO's actions tropical deforestation is running rampant (Sect. 5.1). Trade in tropical timber products has been declining. Only plantation forests and pulp mills in a few tropical countries (e.g., Brazil and Indonesia) have been increasing. I have never seen an objective external evaluation of ITTO's activities.

The fight against illegal logging was cautiously adopted by ITTO also earlier but it did little in this front prior to 2006, when it was explicitly approved as one of its objectives (Saastamoinen 2009).

Tropical Forestry Action Plan was created nearly simultaneously with the establishment of ITTO. However, ITTO never became to any close collaboration to attack tropical deforestation with this new global partnership, which will be introduced next.

5.7.5 Tropical Forestry Action Plan/Program (TFAP)

UNEP, UNESCO, and FAO had a consultation in 1982 about the escalating tropical deforestation. This meeting took place just after the new 1980 assessment results of tropical deforestation were published (Lanly 1982). The meeting recommended a major international involvement on checking deforestation (Douglas and Simula 2010).

At about same time World Resources Institute (an ENGO) had invited UNDP and the World Bank for a global initiative on the same tropical deforestation issue. In 1987 the two activities became integrated as a TFAP, where FAO became the executive agency. TFAP focused on the following themes:

- Forestry in land use,
- Forest-based industrial development,
- Fuelwood and energy,
- Conservation of tropical forest ecosystems,
- An action program on forest institutions.

A TFAP advisory group was established composed of representatives of the members of TFAP, multilateral agencies, and national development agencies. The group supported national forestry programs, their fund-raising and follow-up. In 1993 this group redefined its mandate "to support the formulation and implementation processes of national forest programs and international support frameworks and their interaction" (Humphreys 1996). More than 100 countries were engaged in the implementation of these programs until 1998.

The elimination of tropical deforestation was the main goal of TFAP. No deceleration in tropical deforestation was observed in the 1990 Tropical Forest Resources Assessment (FAO 1993b). Subsequently, three independent reviews were implemented on the assessment of the effectiveness of TFAP. All three reviews were critical to the impacts of TFAP. WWF decided in 1990 to cease funding and supporting TFAP. World Resources Institute made the same decision one year later. "To all intents and purposes, the World Bank was also no longer a participant in the TFAP" (p. 110 in Douglas and Simula 2010).

UNDP did adopt itself as an executive agency in TFAP capacity building since 1992. Rio UNCED in 1992 invited (in Chap. 11 of its Agenda 21) all countries, not only tropical countries, to develop and implement national forest plans and programs. Afterwards, FAO has continued to support these national forest programs in a wider global scale without announcing TFAP terminated (Humphreys 1996).

A conclusion about TFAP can be drawn that it failed to decelerate tropical deforestation of natural forests. Maybe human capital was developed to some extent in a number of tropical countries in the context of national forest planning activities but otherwise the huge funding was wasted. This was so far the most expensive and serious joint attempt by the three leading global formal actors and one global ENGO to decelerate tropical deforestation. Most likely the TFAP planners did not master the underlying causes of deforestation or were not able to cope with the corrupted national government officers.

5.7.6 Rio UNCED 1992 and Its Follow-Up

The resolution 44/228 by the United Nations General Assembly in December 1989 announced that the United Nations Conference on Environment and Development (UNCED) would be convened in Rio de Janeiro in June 1992. The resolution identified protection and management of land resources by, inter alia, combating deforestation, desertification, and drought. Next year nine draft proposals for global forest convention were launched by different global actors (Humphreys 1996).

UNCED in Rio was a mammoth congress with 178 countries signing the key forestry documents of Agenda 21, Rio Declaration, the global conventions on Biological Diversity and Climate Change as well as the Non-Legally Binding Forestry Principles. Agenda 21 was aimed as road map for governments, aid agencies, and other actors on the issues of environment and development until 2000. Chapter 11 of Agenda 21 refers to combating deforestation. The Rio Declaration on Environment and Development was intended to outline the rights and obligations of the governments. The establishment of Commission on Sustainable Development by the UN Economic and Social Council was one more major output of UNCED.

No global forest convention was agreed by UNCED in spite of strong attempts. The opinions between the South and the North were too different to agree. Instead “A non-legally binding authoritative statement for principles of global consensus on the management, conservation and sustainable development of all types of forests” (Forest Principles) (United Nations 1992) was agreed. This was, however, a historical document with its global definition of sustainable forest management (SFM).

> Forest resources and forest lands should be sustainably managed to meet the social, economic, ecological, cultural and spiritual needs of present and future generations. These needs are for forest products and services, such as wood and wood products, water, food, fodder, medicine, fuel, shelter, employment, recreation, habitats for wildlife, landscape diversity, carbon sinks and reservoirs, and for other forest products (p. 2b in United Nations 1992).

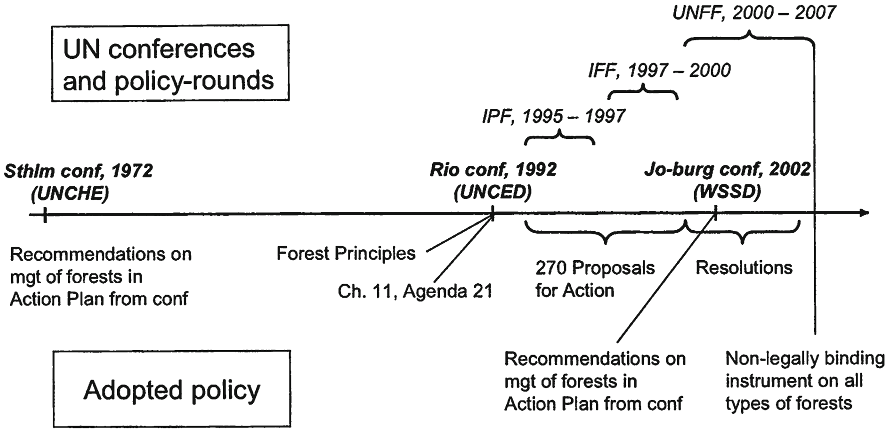

Fig. 5.18 Global forest politics activities by the United Nations since 1972 (p. 24 in Holmgren 2008)

This definition brought a revolution in the concept of forest and sustainable management of forests. A real transition took place from the previous paradigms of sustained yield forestry and multiple use forestry. This new paradigm of SFM presupposed forest ecosystem as a concept of forest. For the first time in history an authoritative adoption of a global definition of ecosystem-based sustainable forestry took place. A number of countries (e.g., Finland) have changed their forest policies to fit this novel definition of SFM.

Also financing of SFM was decided in Rio UNCED to be increased. "New and additional financial resources should be provided to developing countries to enable them to sustainably manage, conserve and develop their forest resources, including through afforestation, reforestation and combating deforestation and forest and land degradation" (p. 10 in United Nations 1992).

Furthermore "Forest Principles" supported the rights of indigenous peoples and women as well as participation of local people and other parties in management conservation and sustainable development of forestry.

The UN Commission on Sustainable Development was aimed to follow-up the implementation of the Rio UNCED agreements. The Commission created an Intergovernmental Panel on Forests (IPF) with four sessions during 1995–1997. Afterwards Intergovernmental Forum on Forests (IFF) was active until 2000. IPF and IFF jointly produced 270 proposals for action. Finally, UN Forum on Forests (UNFF) was established by the General Assembly of the United Nations. UNFF has now a mandate until 2015 (Fig. 5.18).

The United Nations General Assembly issued a non-legally binding instrument on all types of forests in 2007 as proposed by UNFF. It redefined SFM as follows:

> "Sustainable Forest Management, as a dynamic and evolving concept, aims to maintain and enhance the economic, social and environmental values of all types of forests, for the benefit of present and future generations."

This definition has inflated the 1992 definition of SFM by excluding the cultural and spiritual values, transforming ecological to environmental values but maintaining economic and social values.

This instrument has four objectives as follows (abbreviated here):

- Reverse the loss of forest cover worldwide;
- Enhance forest-based economic, social and environmental benefits, including by improving the livelihoods of forest-dependent people;
- Increase significantly the area of protected forests worldwide, and the area of other sustainably managed forests;
- Reverse the decline of official development assistance for sustainable forest management. (United Nations 2007)

Accordingly, the General Assembly of the United Nations passed two times resolutions on global forest politics. This has been an exceptional and unique history of global forest politics with forestry issues on the agenda of the General Assembly.

After 18 years of enforcement and follow-up of Rio UNCED agreements tropical deforestation of natural forests is continuing without remarkable deceleration (FAO 2006, 2010a). The primary task of shutting down tropical deforestation has been obscured by hundreds of other proposals. The motivation of the national governments to determinedly cope with this task has not succeeded, most likely due to wild corruption, which is undermining both effective governance and efficient markets (Sects. 5.1 and 5.2).

5.7.7 Global Forest Politics by G7 and G8 Big Powers

The heads of states with their foreign and finance ministers (occasionally also other ministers) of the seven richest nations have had annual meetings since 1975. The G7 (G8 after annexing Russia) meetings have been hosted in turn by Canada, France, Germany, Italy, Japan, United Kingdom, and the United States (recently also Russia). The idea is to coordinate their foreign and financial politics.

Environmental issues appeared for first time in the agenda of the G7 in 1984 and forestry issues in 1987. This year can be regarded as a historical one, when forestry issues entered global political agenda. Then in 1988 the G7 realized the need to tackle the deforestation of tropical rainforests. Next meeting recognized that deforestation has to be given a priority attention.

In the 1989 meeting in Paris, the G7 called for sustainable forest management and gave a strong support for TFAP. The G7 also called for improved conservation of forests and indicated its readiness to assist tropical forest nations financially and technically.

The 1990 meeting in Houston, Texas, had the longest agenda of forest issues so far. First was a statement that combating deforestation requires more effective international cooperation. Then it mentioned that destruction of tropical rainforests had reached alarming proportions. The G7 demanded also that TFAP must be reformed

with more attention to conservation of biological diversity. Furthermore, the ITTO Action Plan must be enhanced to emphasize SFM and improve market operations. Finally, the G7 expressed readiness to begin negotiations on a global forest convention to curb deforestation.

In 1991 in London the G7 welcomed the spread of debt-for-nature exchanges, with an emphasis on forests. The G7 had minor remarks on forests also in its meetings in 1992–1993. But the summit in Denver in 1997 was highly important. Then the G8 decided to create its own practical action program on forests. Also in 1998 in Birmingham six points on forests were included in the G8 declaration (Sheppard 1999).

In 1993 President Bill Clinton launched "The forest plan for a sustainable economy and a sustainable environment" (Clinton and Gore 1993), which primarily addressed the northern spotted owl controversy in the Pacific Northwest of the United States. This may have had an impact on the adoption of the Action Program on Forests by the G8 members. On the other hand, the global and national NGOs were putting an increasing pressure on governments to curb tropical deforestation. Ultimately, the G8 launched the Program to respond the public alarm over huge forest fires in 1997–1998 in Indonesia, Brazil and Mexico (Palo 2001a).

The G8 Action Program on Forests was designed for 1998–2002. No respective organization was created and no specific funding for the implementation was available. Still the Program has had some impact on global forest politics. The Program covered five themes as follows:

1. Monitoring and assessment;
2. National Forest Programs;
3. Protected areas;
4. Private sector;
5. Illegal logging.

The G8 members have afterwards put a lot of effort on the last issue of illegal logging. The Heads of States reiterated their commitment to combat illegal logging in the Okinawa Summit in 2000. This fight against illegal logging and corruption was internationally mobilized by this Program. The next year, e.g., the FAO for the first time in its history published an analysis of corruption in forestry and instruments to curb it (Palo 2001a).

Horst (2001) was quite critical about the success of the G8 Action Program on Forests. He concluded that it had nothing to offer, either content-wise or financially, especially for developing countries. In fact, the program was aimed just to complement the ongoing UN activities during the IPF and IFF processes. Program design and planning were inadequate. Program implementation and its follow-up rested mostly on already ongoing national activities. The G8 Action Program on Forests seemed to be more about rhetoric than effective implementation.

On the other hand, some positive aspects could be identified. The Heads of the G8 member states can be assumed to be quite selective in their agenda formulation. Therefore, the Action Program on Forests on the agenda of the G8 in 1998 can be regarded as a historical event. There did not then exist any respective program on other sectors.

The Program's strength was in its brevity and the limited number of countries under its focus: eight member countries and eight partner developing countries. The five points in the Program were well chosen to support SFM (Palo 2001a).

After the Action Program on Forests only in the 2008 Summit in Hokkaido Toyako, Japan, the declaration referred to forests. It encouraged actions for Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (REDD). The G8 also welcomed the G8 Forest Experts' Report on Illegal Logging. The Summit promised to make all possible efforts by ensuring close coordination among various forums and initiatives with a view of promoting effective forest law enforcement and governance and SFM worldwide. The G8 also wanted to enhance cooperation to combat forest fires (MOFA 2008).

5.7.8 Global Forest Politics by the World Bank

The G7 and G8 have had impacts on the forest policies by FAO (above), the World Bank and other intergovernmental organizations (IGOs). The G7 criticism on TFAP in 1990 gradually withdraw the bank out of TFAP funding. The bank has also been sensitive to other environmental issues, while the G7 and G8 have adopted new lines in their declarations.

The World Bank was established in 1944 as single body for reconstruction and development after the Second World War. Today it is a closely associated group of five development institutions. The mission of the bank is to alleviate poverty worldwide with particular reference to developing countries (World Bank 2010).

The international banks and national donor agencies initiated their donor and financing activities in forest sectors of developing countries during the 1950s. Their financing increased first rather slowly, but became more standard practice during the 1970s. Therefore, it also became common for these agencies to express policy lines of future priorities. For example, USAID (1972) expressed fast growth of planted trees as the first future advantage but stressed also the role of environmental forestry benefits.

Robert McNamara, the new President of the World Bank, brought up in 1973 a new approach for the bank in his book, "One Hundred Countries, Two Billion People." "For hundreds of millions of these subsistence farmers, life is neither satisfying nor decent. Hunger and malnutrition menace their families. Disease and death visit their villages too often, stay too long, and return too soon" (McNamara 1973).

The book continued that the poor farmers in developing countries have not been able to participate in the "Green Revolution." They cannot afford to pay for the irrigation, the pesticide, the fertilizer, or perhaps for the land itself. The title of land may be vulnerable and their tenancy uncertain.

As a consequence, the World Bank (1978) introduced its "Forest Sector Policy Paper," which particularly stressed environmental and rural development aspects. It argued that the consequences of uncontrolled forest exploitation are of critical concern to mankind, for they could lead to serious environmental disruption and increased rural poverty (Photo 5.26).

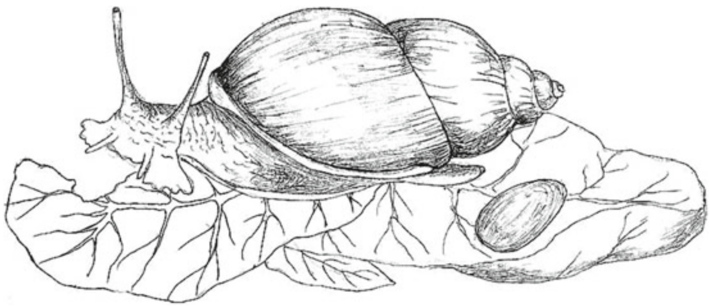

Photo 5.26 A giant snail (*Strophocheilus popelarianus*) has been a delicacy of local indigenous people in the rainforests of Amazonia in Ecuador. It can weigh about half a kilogram. Its population and market income have been threatened by expanding logging and forest degeneration (Córdova 2001)

The Bank's strategy paper continued that due consideration had to be devoted also to fuelwood, since its share in developing countries is more than 90% of the total wood consumption. The priority future tasks were identified as follows: environment, rural development, industrial forestry, and institutions. Only fragments of Westoby's (1962) views on "Role of forest industries in the attack of economic underdevelopment" remained in the report.

The bank has been annually publishing "World Development Report" along with other publications. The theme of the report has changed and the numerous statistics have been updated annually. Twice the bank has devoted its report to poverty (World Bank 1990, 2001). Poverty has been measured with monetary indicators but also after 1995 with the Human Development Index (UNDP 2009), which measures not only income but also health and education.

The bank carried out its first major forestry project in the world in 1971–1975 in Finland based on a national forest program (Mera III). Another special feature of this project was its wide coverage of intensification of forestry management via investments in drainage of peatlands, fertilizing forests, tending of young plantations, and in constructing logging roads. However, the most northern part of Finland was excluded from this project primarily due to low profitability of investments there (communication by Christian Keil).

Later on, forestry projects never played any major role in financing by the bank. The share of forestry investments has varied between 1% and 2% of the total investments by the bank. The total forestry lending by the bank was 678 million USD in 2008.

The bank made its second strategy to guide forestry investments in 1991. The most striking novelty in this strategy was the exclusion of logging in primary tropical moist forests from the investment portfolio of the bank. This was a consequence of strong lobbying by NGOs and sensitivity of the bank to criticism by the media (Douglas and Simula 2010). Typical forest field projects were mostly devoted to afforestation and human capacity building (Box 5.10). However, corruption has also handicapped development projects in forestry in India (Box 5.11).

Box 5.10 In Support of State-Wide Field Projects: World Bank-Financed Forest Sector Investment Projects in India in the 1990s (Keil 2010)

The preparation phase of a comprehensive forestry investment project by the World Bank and the recipient country regularly took 2–3 years before the bank's disbursement of funds to the project started. The broader framework for project design was determined by a sector analysis of forestry, if expedient also of forest industries, at the national level, supported by the bank's global Forest Policy as well as by the bank's country-specific so-called Country Policy Paper. Also a region-wide forestry investment strategy by the bank, covering all of Asia, gave guidance. Furthermore, some countries, such as India, had their own explicit forestry sector policy. The entirety of this considerable sector work determined the frame for new, bank-assisted forestry projects.

The World Bank started financing statewide forestry projects in India since the mid-1980s. By the late 1990s, a considerable number of Indian states had their bank-assisted forestry projects in place at a total investment volume surpassing half a billion USD. The three forestry projects in the states of Maharashtra, Andhra Pradesh and Kerala are typical examples of the bank's financing activities in India. Their aggregate cost was more than 250 million USD, of which the bank covered 85%, the remainder being Indian finance. It has not been common in India to have other co-financiers, such as bilateral development financing agencies, participate in such projects; quite different from India, this used to be rather normal practice e.g., in Africa.

The above-mentioned three Indian statewide forestry projects had typically three main components, each with a number of sub-components, as follows.

Strengthening of the entire state's forest sector, including: institutional and policy reforms; multidisciplinary training of forestry personnel at various levels; comprehensive studies aiming at the modernization of the forest service; computerization throughout the forest administration and establishment of necessary data bases; modernization of offices, car fleets and communication systems; establishment of modern information systems to steer silvicultural and administrative measures; and the introduction of modern forest inventories supported by remote sensing techniques and global positioning systems.

Direct support for silvicultural field operations, particularly those aimed at improving degraded forest land, including: intensified forest protection and large-scale reforestation; participative forest management with local rural communities; increasing the productivity of production forests by genetically improved seed and plant material and through improved planting and tending methods; more efficient protection from forest fires; strengthening and re-directing forest research toward more relevant goals; and supporting private mini-plantations in home gardens and fields.

(continued)

Box 5.10 (continued)

Support to nature conservation in forestry, including: inventories of biological diversity; improving or expanding existing conservation forests and nature parks; information campaigns and the promotion of eco-tourism.

The lengthy process of project preparation was typically carried out by several World Bank-led multidisciplinary missions of up to 7–8 foresters and other experts drawn internationally and from India. These teams would work intensely together with the counterpart organization of the Indian state in question. An ex-post analysis of the above-mentioned three Indian forestry projects after their completion showed that they had succeeded well and have been able to generate sustained improvements in the forestry sector.

Box 5.11 Many Dimensions of Corruption in the Forest Sector of India (Pradipta Halder)

Corruption is defined as the abuse of entrusted power for private gain according to Transparency International (Transparency International 2009). Another definition reads as "corruption is a complex social, political, and economic phenomenon that affects all countries by undermining democratic institutions, slowing down economic development and contributing to governmental instability" (UNODC 2010). Transparency International publishes the Corruption Perceptions Index (CPI) annually. It ranks countries according to the perceived level of corruption.

India ranked at 84 from the least corrupted country among the 180 countries on the CPI list in 2009 (Transparency International 2009). India's rank has been on a steady decline during recent years, which indicates an increasing rate of corruption. This increase in perceived corruption has taken place despite the proclaimed anti-corruption measures taken by the government, which has launched e.g., the Prevention of Corruption Act of 1988 and the Right to Information Act of 2005.

Corruption in India is due to many factors – the activities of the politicians being the most important ones (Transparency International 2003). It does not only affect ordinary citizens in their daily life but the rampant corruption and bureaucratic red tape stifle progress by causing unnecessary delays and cost increases for business in India (UICIFD 2010).

More than 90% of the forests in India are owned and managed by the government.

Accordingly, private forests are negligible and they are mainly used for timber, pulp, and paper production by only a handful of industrial houses.

(continued)

Box 5.11 (continued)

Although the decades-old Joint Forest Management (JFM) program has produced some benefits to the local forest-dependent communities, JFM's progress has been sporadic and often controversial. It has also been argued that local politicians, forest department officials, and timber mafias have taken the benefits of the JFM and thus undermined the rights of the local people.

In a major policy shift the parliament has enacted the Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act of 2006 to "undo the historical injustices" suffered by tribal communities in India (Bhullar 2008). Under this Act the government intends to distribute forest land of 2.5 ha/each to the 20 million tribal nuclear families. If fully implemented, this act would mean distributing 50 million ha to these families out of the total of 68 million ha of forests in India (Singh 2005). It was argued and feared that only 22% of the total land area of India is under forest cover and this land distribution would result in fresh encroachments, loss of forest cover and transfer of forests to the hands of the land and timber mafias (Rithe 2006). The success of this program relies heavily on the willingness of the bureaucrats and officials in the government at all the levels to perform this huge task sincerely and honestly without being fallen prey to the political-mafia nexus.

Illegal logging is widespread in India though not all the cases are reported to the authorities. Bribery is believed to be the common practice to let it go unnoticed. Illegal logging takes place mainly in two ways – either for one's private consumption for fuelwood or construction or for markets. The latter takes place in larger scale and is more harmful for the local communities. This kind of large-scale logging can hardly happen without support by the local politicians and forest department officials.

There exist no effective mechanisms to stop this kind of illegal logging as the laws and rules are not enforced properly and the offenders often go unchecked by the authorities. Often government officials are unable to stop illegal logging even if they have good intentions to improve the conditions of forest and forest-dependent communities in their jurisdiction. The political interference is very high in the stakes of forests in India. Often the forest officials are at the mercy of the politicians.

Illegal logging is visible also in the protected forests in India. The dwindling number of the tiger population is the most striking example of this sad but true story. The poaching has not stopped even after the governments set up a Tiger Task Force to prevent this menace. Not only tiger but also other rare and endangered animals and plants are victims of rampant poaching in India.

Politicians and local mafias normally take advantage of poor and unemployed youth and lure them to commit this crime. The political-mafia nexus is so strong that judiciary is unable to take steps even though the "big fishes" are caught and brought to the court. Unfortunately, all the public sectors are perceived to

(continued)

Box 5.11 (continued)

be highly corrupted in India and the forest sector is no exception. Corruption in India is like a “Pandora’s box” – the more one opens it, the more will be found. India is not among the worst corrupted countries according to CPI. Still the country is not a good example in fighting against corruption.

India has been among the fastest-growing economies in the world. Building and infrastructure development companies have been booming for a number of the most recent years. Wood is an essential raw material for these industries. Domestic supply of is not enough. India has imported wood from other tropical countries such as Ghana, Malaysia, and Brazil. There exists no forest certification scheme in India. Therefore, the concept of sustainable forest management still remains in its infancy. India neither has any chain of custody system to track the origin of wood. The imports of illegally logged tropical timber is equivalent to corruption.

Recently there have been a few important global initiatives, such as the Forest Law Enforcement, Governance and Trade (FLEGT) by the European Commission and the Forest Governance & Integrity Program (FGI) by the Transparency International. Their aims are to curb the trade of illegally logged tropical timber and to reduce deforestation and forest degradation in those countries. India most likely soon will be a member of these initiatives.

The recent assessment by the government indicates that India’s forest cover has increased, which has often been considered as a success in the fight against deforestation. However, forest cover has increased due to the expansion of plantation forests. The loss of natural forests has not been stopped. This has serious implications on India’s biodiversity since the plantations are monocultures and they do not enhance biodiversity. Doubts also survive concerning the survival of the plantations and concerning the calculation methods of plantation areas.

Government cannot have a success in fighting alone against corruption in India. Citizens must be aware of the devastating effects of corruption in their lives. Corruption in the forest sector brings social, economic, and ecological disasters and derails any sustainable development path. Therefore, every Indian citizen has to fight against corruption in the all spheres of the society – not only in the forest sector.

From the governmental perspective it is important to enhance the intrinsic value of the Indian forests to prevent their destruction for short-term benefits. The devolution of forests from public to private ownership may take several years in India. However, the devolution will not produce desired results unless corruption is not first eradicated from the society. Imparting proper forestry and environmental education and extension services, conducting relevant research and providing factual information, and spreading awareness among the public can go a long way to fight against corruption in the forest sector of India.

The World Bank's 1991 Forest Strategy and the 1993 Operational Policy constrained the bank from adequately engaging the forest sector activities and largely also prevented the bank from participating the international and national forest dialogue (World Bank 2002). Accordingly, a preparation for a renewal of the forestry strategy was initiated in 1998.

The 2002 Forest Strategy comprises three equally important and interdependent pillars (p. 12 in World Bank 2002):

- Harnessing the potential of forests to reduce poverty;
- Integrating forests into sustainable economic development;
- Protecting vital local and global environmental services and values.

In preparation of the new forests strategy there appeared strong campaigns by various NGOs on the contents of the strategy. Especially the wealthiest global NGO, Conservation International, wanted to depart from SFM to a purchase of a conservation concession after initial logging of the most valuable timbers. There was a case in Bolivia where this approach had been successful but it was argued to be too expensive in the whole of the tropics and also the circumstances in other parts of the world had not been so favorable as in Bolivia (Douglas and Simula 2010).

The bank favors strong partnerships with NGOs for building consensus and momentum for the bank's agenda on forests. The alliance with WWF aims for forest conservation and sustainable use. It had already in 2002 demonstrated its merit, drawing on the strengths of each partner to mainstream dialogue on important issues. The alliance has worked with varied partners in order to establish 50 million ha of new protected forests, another 50 million ha of intensified management of threatened existing protected forests and 200 million ha of commercial forests under independently certified sustainable management by 2005 (World Bank 2002).

As a conclusion an implication of this review is that the World Bank may have succeeded better both in *de jure* and *de facto* in supporting sustainable forestry than ITTO or FAO. A high number of formal and informal institutions have been active in support of SFM since the UNCED conference in Rio de Janeiro in 1992 (Fig. 5.19).

5.7.9 Johannesburg and FLEG Forest Politics

After 10 years of the Rio UNCED a new World Summit was convened in Johannesburg, South Africa. The Johannesburg Declaration first expressed the participants' willingness to support sustainable development: "We recognize that poverty eradication, changing consumption and production patterns, and protecting and managing the natural resource base for economic and social development are overarching objectives of, and essential requirements for sustainable development" (paragraph 11 in United Nations 2002a).

The Johannesburg World Summit Plan of Forestry Implementation was included in paragraph 45 of the overall Implementation plan. It indicated first that forests are

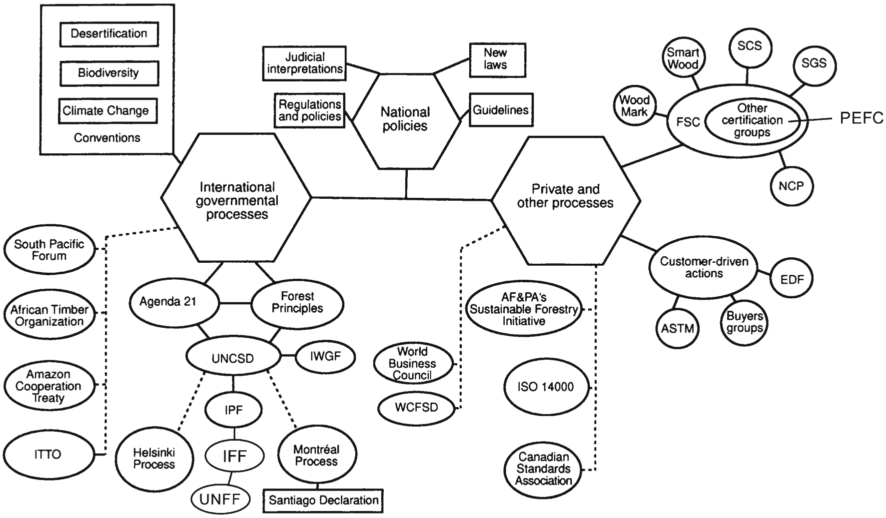

Fig. 5.19 Global forest and environmental politics since the 1992 Rio-UNCED: sustainability policies by formal (*on the left*) and informal (*on the right*) global actors.
Source: This chart is adapted from a memo prepared by C.N. Owen.
Note: *AF&PA* American Forest and Paper Association, *ASTM* American Society for the Testing of Materials, *EDF* Environmental Working Group on Forests, *SCS* Scientific Certification Systems, *SGS* Société Générale de Surveillance, *UNCSD* UN Commission on Sustainable Development, *WCFSD* World Commission on Forests and Sustainable Development.
PEFC Programme for the Endorsement of Forest Certification Schemes, *IFF* Intergovernmental Forum on Forests, *UNFF* United Nations Forum on Forests

an essential part of sustainable development to eradicate poverty, and significantly reduce deforestation and land degradation. Law enforcement, support to IPF/IFF processes and the Convention of Biological Diversity as well as support to indigenous and community-based tenure systems were also stressed (United Nations 2002b).

In 1996 IPF identified illegal logging as an issue worthwhile to clarify its nature and extent. The G8 Action Program on Forests (1998), FAO (2001a), and this Johannesburg Plan all stressed the importance of preventing illegal logging and corruption. Forest Law Enforcement and Governance initiative (FLEG) became launched also with a support of Transparency International and some other NGOs. Illegal logging, associated with illegal trade and corruption, undermines any nation's attempt to achieve SFM (Sect. 5.1). The World Bank estimates the global annual loss from illegal logging as 10 billion USD, which is more than eight times the official development aid (ODA) to SFM (Tacconi 2007; World Bank 2010).

The World Bank has been engaged in FLEG since its first regional meeting in Bali in 2001. This activity is clearly expressed in the Bank's 2002 Forestry Strategy. FLEG aims first to study the causes of inaction and economic, social and environmental consequences of illegal logging. Second, regional ministerial meetings are

organized with the aim to support agendas of action against illegal logging. Third, the FLEG encourages the implementation of national action plans agreed at the regional ministerial meetings.

The East Asian Ministerial FLEG Conference was held in 2001 in Bali, Indonesia. The Bali Declaration indicated that illegal logging and illegal trade threaten ecosystems and biodiversity. The ministers declared that they will address illegal logging and associated illegal trade and their negative effects. Twenty countries participated, of which 11 at the ministerial level. Additionally, IGOs, NGOs, and private sector representatives attended. The delegates totaled 150. In 2002 a regional task force and advisory group were established. A number of national follow-up meetings have been organized later.

A Ministerial FLEG Conference for Africa was organized in 2002 in Yaoundé, Cameroon. Three hundred participants from 39 African countries, IGOs, NGOs, and the private sector attended. A number of national follow-up meetings have been organized since then. About the same time FLEG activities were mobilized among eight Amazon countries and eight Central American countries. Also FAO and ITTO have joined some FLEG activities. A high number of special studies have been carried out at regional and national levels and on certain technical issues.

Contreras-Hermosilla (p. 44 in 2007) concluded that progress in the FLEG Program implementation has been variable by countries. One major obstacle has been the complexity of the needed reforms. “FLEG initiatives can succeed when resolute leadership, devoted to implement reforms, exist.” One of the recommendations emphasizes incentives and targeted awareness raising, as well as information and educational programs.

5.7.10 Climate Change Politics

A global initiative was launched in 2008 by UNDP, UNEP, and FAO to reduce emissions from deforestation and forest degradation (REDD). Australia, France, Japan, Norway, the United Kingdom, and the United States collectively agreed to allocate 3.5 billion USD as initial public finance toward slowing, halting, and eventually reversing deforestation in developing countries in the United Nation’s Copenhagen Conference on Climate Change. This funding will be channeled via REDD+ during 2010–2012 (UK Government 2009).

A nucleus underlying REDD+ is to make performance-based payments to forest owners and users to reduce carbon emissions by decreasing deforestation and forest degradation. The process is expected to have co-benefits, such as support of biodiversity and other environmental services, poverty alleviation, improved governance and human rights, and climate change adaptation (Angelsen 2009).

The carbon supporting payments provide incentives to forest owners and users to clear less forest and to manage forest better. Forest owners are expected to sell more carbon credits and less cattle, palm oil, coffee, cocoa, or charcoal. The opportunity cost of sustainable forestry is lowered enough for this end.

Some number of barriers have appeared in implementing such payments with respective conservation impacts. Most critical deforestation locations are characterized by unclear and contested tenures. However, the whole system rests on the idea that land tenure and carbon rights have to be clearly defined. The carbon stocks in forests have to be monitored regularly at the same scale with payments. Also new institutions have to be created to govern the carbon credit system and to link the local to national and global REDD+ systems.

Many past efforts in decelerating tropical deforestation have failed. Angelsen (2009) identifies two fundamental reasons for this situation. There has been a failure to address the relevant drivers and the tendency not to cover inter-sector factors. Four main types of policies to curb deforestation are suggested: decreasing agricultural profitability on deforested sites, increasing the value of standing forests with enabling forests users to capture that value, direct regulation of land use, and cross-sector policies that underpin the first three options.

On the monitoring front a huge capacity gap still exists. “A recent review shows that only three out of 99 tropical developing countries have very good capacity for monitoring forest area change and forest inventories” (p. xiv in Angelsen 2009). Improved monitoring systems are a must for more effective performance-based payment systems.

Large financial flows of REDD+ to developing countries have raised under prevailing conditions concerns about expanding corruption to undermine deceleration of deforestation and forest degradation. Improved monitoring, reporting, and verification systems are expected to act as preventive medicine in this front.

> As long as REDD+ is performance-based and receives high levels of national and international scrutiny, there is reason for optimism. But anti-corruption policies limited to forest sector are unlikely to work in countries with high corruption levels, which require systemic institutional changes (p. xv in Angelsen 2009).

Illegal logging is closely linked with corruption. If corruption could be suppressed, then also governance would become more effective. Especially also by adopting reduced impact logging together with improved wild fire control carbon emissions could be sustainably reduced and carbon sequestration increased. Active restoration of existing degraded barren hills and better post-logging forest management would further enhance the situation (Angelsen 2009).

The global community has already demonstrated strong willingness to pay for REDD+ and many developing countries have shown strong willingness to receive increasing funding via REDD+ with its linked responsibilities. This match of two willingnesses is the backbone for a global success, but some number of doubts will remain. Furthermore, a number of business corporations have been motivated to establish forest projects in the tropics with carbon sequestration and conservation of carbon stocks as their aims (Box 5.12).

As a conclusion how can the prevailing socialistic forestry (Sect. 5.1) with wide corruption and deforestation be transformed in any available planning horizon into a transparent, effective, cost efficient, and fair sustainably managed forestry? For us this is a distant utopia! Law and order with major and profound tenure reforms are the cardinal preconditions. The relevant institutional reforms require also strong political support and too long time.

Box 5.12 Forest Carbon Sink – Peugeot/ONF in the Amazon (Stéphanie Deffontaines)

Peugeot is the leading carmaker in Europe for vehicles with low CO_2 emissions and since 1978 this French company works on an international scale. At the autumn of 1998, Peugeot decided to undertake a vast scientific and ecological sponsorship campaign by fully financing an innovative reforestation project with a view to carbon sequestration, over a period of 40 years in Amazonia, with the support of the French National Forestry Board (ONF) for implementation, just shortly after the signature of the Kyoto protocol.

The interest of Peugeot in this reforestation project
To become the effective leader of all its automotive competitors in control of greenhouse gases, Peugeot has made an intensive R&D effort over at least a decade. The strategy of the company is to maintain and strengthen her leadership.

Nowadays in a fast-moving world, the energy price is high and European governments are trying to take into account the major environmental issues. The automotive taxation is tending to be based on the carbon footprint of vehicles. The interest of Peugeot is to stay the leader in the control of greenhouse gases and use it such as a growth driver that should be accentuated. The aim of the company is going toward continual improvement of the motorcar's integration into the environment. This reforestation project is part of the group process.

Peugeot has chosen to locate its project in Brazil because in 2000 the company opened a factory in the Brazilian state of Rio. This project allows the company to show its continued commitment to the Brazilian people. The presence of a local partner, the NGO Pro-natura, supported their choices.

Moreover, the global importance of the Amazon forest basin as "carbon sinks" and biodiversity reserve was also a rationale location to fight against the greenhouse effect and reach the ecological issues. Now, the important role played by Brazil in United Nations Framework Convention on Climate Change support the perfect choice for the site.

The characteristics of the site: Fazenda São Nicolau
In 1999, Peugeot buys the Fazenda São Nicolau in Cotriguaçú district but the property is acquired by the ONF with the help of the NGO Pro-Natura. Peugeot did not want the property rights. She contains 10,000 ha with 7,000 ha of primary forest, 2,000 ha of grazing lands and 1,000 ha of Cappoeiras (degraded forest). These last 3,000 ha need to be reforested and the 7,000 ha of primary forest contains 1,500 ha of Ripisylve (forest along river) around the Rio Juruena, which have a high ecological value.

The site is situated in the Brazilian state of Mato Grosso (Map 5.5), south-east part of Amazonia that corresponds to the "agricultural pioneer front." Indeed, in this region, the Amazon forest is under great pressure due to the

(continued)

Box 5.12 (continued)

Map 5.5 Location of the site (Bocqué and Behaghel 2008)

expansion of agriculture with people migration from other part of Brazil (Map 5.6). This part of Amazon forest is the most touched by deforestation in Brazil. The main activities of this area are agriculture and husbandry where small farmers and indigenous communities try to survive around big landowners (Fleury 2005).

The site is isolated at more than 9 h of tracks from the capital of Mato Grosso, Cuiabá. Before planting, lots of work has been realized to provide infrastructures such as track maintenance and creation, water network channeling, development of the buildings required for the project, and delimitation of the land ownership.

To implement the project in a sustainable manner, they have perfectly understood that they need to take into account the socio-economic and ecological conditions of the site.

Relation between local communities and the project
According to the ONF, ecosystem protection and local development are complementary. Local population is included in the project through environmental awareness projects and forestry use. Since 2006, small farmers, from the

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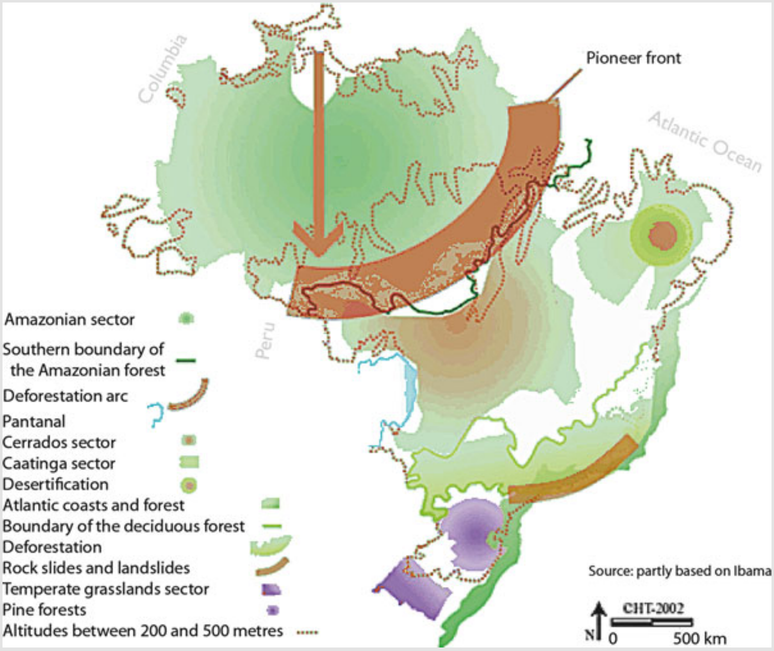
Box 5.12 (continued)



Map 5.6 "Agricultural pioneer front" in federal Brazil (the *arrow* from the *top down* identifies the Peugeot/ONF site) (Bocqué and Behaghel 2008)

Cotriguaçú district and the neighboring district *Juruena*, can harvest nuts in the 7,000 ha of primary forest. The aim is to demonstrate that forest can provide an income for local communities. Nuts are sorted and dried in the *fazenda* before going to the *Juruena* district to be husked and packed. This small factory was established in partnership with the program "GEF/PIC" of UNDP, gatherers can avoid intermediaries and sell at a better price to a buyer's network established by the UNDP.

The next step for the project will be to diversify collected products such as açai and babaçu and increase the number of beneficiaries. The project wants to strengthen its socio-economic role in the local environment. This project seems to be a beginning of a social forestry project such as Community Forestry. Community Forestry is any situation that intimately involves local people in a forestry activity. It embraces a spectrum of situations ranging from woodlots in area with short of wood and other forest products for local needs, through the growing of trees at the farm level to provide cash crops and the

(continued)

Box 5.12 (continued)

processing of forest products at the household, artisan, or small industry level to generate income (FAO 1978).

The integration of the project in international forest policy
The ONF works hard to prevent the global warming and for greater recognition of the contribution of forests to its efforts. The first objective of the project was to demonstrate that it is possible to reforest with local species and to show the contribution of forest to prevent the global warming by biomass production. The ONF has involved lots of research institutes that are now partners of the project such as UFMT, UNEMAT, INPA-Manaus, USP-CENA and IRD. In 2010, 2,000 ha had already been reforested and many studies were carried out about carbon sequestration and biodiversity reconstitution.

The objective of the carbon sink Peugeot/ONF is to experiment and demonstrate the important role of forest. The project has never tried to enter in the framework of CDM. Moreover, many rules of the CDM were established after the beginning of the project. However, the monitoring of carbon sequestration follows an international methodology IPCC that is a referral officer for the Kyoto Protocol and the United Nations Convention on Climate Change. The objective of the project is to get a quality label VCS the most rigorous standard for the no-CDM project. The carbon credits obtained from the VCS validation are sold and carbon revenues are reinvested in the project, to ensure the sustainability of the project.

The REDD program created after the Bali conference is more a program that would compensate emerging economies for protecting their forests whereas the CDM is more focused on Western companies building renewable projects in the developing world. How can the carbon sink Peugeot/ONF take part in the REDD program? Many questions remain about how to do a comparison between a sustainable management of forest and deforestation and by which financial mechanisms should be encouraged the afforestation?

Abbreviations Used

GEF/PIC	Program for Conservation and Sustainable Use of Biodiversity in the northwestern Mato Grosso/PIC section – Programa Integrado da Castanha
UNDP	United Nations Development Programme
UFMT	Federal University of Mato Grosso
UNEMAT	Universidade do estado do Mato Grosso
INPA-Manaus	National Institute for Research on Amazonia
USP-CENA	University of São Paulo
IRD	French Research Institute for the development
CDM	Clean Development Mechanism of the Kyoto Protocol

(continued)

Box 5.12 (continued)

IPCC	Intergovernmental Panel of experts on Climate Change
VCS	Volontary Carbon Standard
REDD	The United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries

5.7.11 Discussion and Conclusion

In this section I have introduced and discussed global forest politics and policies. In 20 years we have seen a historical breakthrough and expansion in this front. The arena of global forest politics has also become quite complex (Fig. 5.19). Biased conceptions of the fundamental underlying causes of deforestation and missing political will at the national level have prevented effectiveness in these politics and policies to close down tropical deforestation.

For example, Humphreys (2006) has defined neoliberalism and transnational corporations as basic actors in support of deforestation. He did not realize the missing role of the stumpage markets in increasing the value of forest under prevailing socialistic forestry and consequent too high social opportunity cost of sustainable forestry.

Here I have excluded the conventions on biodiversity and desertification, on trade of endangered species (Humphreys 2006; Saastamoinen 2009). Especially the convention of biological diversity has had a strong global impact on forest management but primarily in boreal and temperate forest zones. The key roles played by NGOs as drivers of changes in global, international, and national forest politics and forest certification systems will be introduced in the forthcoming book. Also forest certification so far has had only a minor impact on management of tropical forests.

This section has paved the way to further understanding of the problems encountered in *de jure* and *de facto* globalization of forest politics. I have reported some of my personal experiences with global forest policy makers in Box 5.13. Global *de jure* forest policies can be regarded wide and advanced but *de f*acto policies has depended on the national governments, which have not so far been motivated to decrease corruption and slow down deforestation. It has been interesting that *de jure* transitions in development paradigms have been reflected also *de jure* implementation of field projects by FAO but *de facto* transitions toward sustainable forestry have so far been missing.

Accordingly, tropical deforestation and forest degradation of natural forests have continued unabated in spite of multiple global forest politics.

Box 5.13 Matti Palo's Personal Experiences with Actors of Global Forest Politics

I started my research career in March 1963 at the Finnish Forest Research Institute Metla in Helsinki, Finland. Later the same year I had the opportunity to study the revolutionary paradigm of "The Role of Forest Industries in the Attack on Economic Underdevelopment" at the University of Helsinki, when Jack Westoby (1962) gave a guest lecture about his novel findings. I later met him a couple of times at the headquarters of FAO in Rome with some informal discussions. He was an impressive personality. Westoby retired in 1975 from the vacancy of the Director of the Division of Forest Policy and Statistics.

Professor N.A. "Nisse" Osara returned from the vacancy as a Chief of Forestry and Forest Industries Division of FAO to Helsinki in 1968. I had my office next to his at Metla. Then I learned more about his early vision about the coming age of tropical plantation forests, which took some decades, however, to have a wider take-off. Osara wrote about the great prospects of coniferous plantations (Osara 1972). The successful breeding of eucalypts and the method of sulfate pulping of non-coniferous species were not yet fully developed in the 1960s. Nisse was also a practical forester managing keenly his family forest estate in Hämeenkyrö 200 km north of Helsinki.

Dr. Alf Leslie (1968), who later served FAO as the Chief of the Forest Products Division, expressed his belief in the potential of tropical forestry for economic development. Leslie maintained Westoby's (1962) approach that forest industries had well-developed external economies and foreign exchange earnings and import replacement capacity. I had the opportunity to discuss with Alf Leslie his paradigm (Box 4.12), when I was briefing him at the Forestry Department, while serving as a consultant to FAO around 1980.

I reviewed the theory of forest-based development in my article on "The Forest-Based Development Theory Revisited with a Case Study of Finland and Prospects for Developing Countries" (Palo 1988). This paper benefited from my mutual discussions with the two leading authorities in the field. My most recent revision was compiled in Sect. 2.6 above.

Later on I got to know a few more directors of FAO's Forestry Department. In 1990 I was invited to give a sub-plenary presentation on underlying causes of tropical deforestation at the IUFRO World Congress in Montreal, Quebec, Canada. After our session was closed C.H. Murray of Trinidad and Tobago, the Head of FAO's Forestry Department, invited me to his cabinet for further discussion and drinks. He had liked my findings and policy implications. He promised to try to support them at FAO.

In December 1995 I traveled with Dr. Jussi Uusivuori to Rome to meet Assistant Director General, Dr. David A. Harcharik of the United States, Head of the Forestry Department. We were with Jussi mobilizing a new global

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Box 5.13 (continued)

research program on "World Forests, Society and Environment" (Palo 2001b) in a partnership with Metla, WIDER, and EFI. We wanted to make sure that there were no conflicts with FAO, which had decided to publish biannual "State of the World's Forests" with the first issue in 1995. No conflicts appeared. Harcharik wanted to brief us about the new strategy of the Forestry Department. I got an impression that the Department had a Head with a clear vision ahead.

The Forestry Department was divided into a number of divisions. Dr. Jean-Paul Lanly of France was then the Director of Forest Resources Division. While we were still in Rome Lanly invited us to a meeting with him and his staff of ten foresters. He was absolutely determined that FAO has the global mandate on forestry. There existed, according to him, no space for other global actors – not even in research. FAO had, however, its mandate on global forestry as an executive body and not as a research agency. We told Lanly that we already agreed on this new research program with Harcharik. So he was knowledgeable of Harcharik's decision of FAO's cooperation with us.

We returned back to Helsinki convinced that we shall have a good coordination and even some cooperation between FAO and us in global forestry research. However, a close colleague told us that Lanly had not yet given up the case. He had sent a message with Professor Aarne Nyyssönen to Jan Heino, the Chief of the Forestry Department of Ministry of Agriculture and Forestry, that FAO disqualified our global research program. We went to see Heino in this matter only to hear him tell us that the financing of 1.5 million FIM by the Ministry had been cancelled.

I called immediately Minister Kalevi Hemilä. I reminded him that he had promised us this funding and Dr. Harcharik had agreed. Now Heino is rejecting it. Who is the decision maker here? Hemilä finally gave us the sum he had promised earlier. FAO can have a long hand and the decisions are not always going top down. Lanly belonged to the generation of division chiefs who had been used to run their own divisions passing the level of the Forestry Department.

I met Dr. Lanly again and last time after his retirement from FAO in the World Forestry Congress in Quebec, Canada, in September 2003. He had a 30-min keynote address on tropical deforestation and I had a 10-min paper presentation after him. I started my presentation by critically reviewing his point that the primary underlying cause of deforestation is clearing forest for agriculture and thus outside forestry. I said that the primary cause was the underpricing of stumpage in tropical forests due to corruption and thus inside forestry. FAO during nearly half a century of its existence has not done anything to solve this problem of socialistic forestry. When the session was over Lanly furious accused me of unfair criticism.

(continued)

Box 5.13 (continued)

Photo 5.27 The advisory board of the “World Forests, Society and Environment” research program hosted by Dr. Hosny El-Lakany, the Assistant Director General of FAO (*in the middle*) at the top terrace of FAO Headquarters building in 1998. Philip Wardle of UK, the chairperson of the board, third from the right. Dr. Jussi Uusivuori, the Deputy Director of the program, fifth from the right (Photo: courtesy of FAO)

In 1998 I participated a public hearing on forests in St Petersburg by the World Commission on Forests and Sustainable Development. Previous Minister of Environment Emil Salem of Indonesia and previous Prime Minister Ola Ullsten of Sweden were co-chairing this commission, which held public hearings on different continents. In this meeting Dr. Nigel Sizer of the World Resources Institute – a global NGO – had been invited to publish its fresh maps of the remaining frontier forests. I was not able to launch any of our research findings to be included into the report of the hearing. The Commission finally published a summary report on “Our Forests – Our Future” (Krishnaswamy and Hanson 1999). The Commission was an NGO. It never received the impact on global forest politics it was striving for.

Dr. Hosny El-Lakany of Egypt was nominated as a follower of Harcharik, when he became nominated as a Deputy Director General of FAO. I met El-Lakany in December 1998 at FAO in Rome. He was cooperative toward our “World Forests, Society and Environment” global research program. He hosted our 3-day meeting of the advisory board of the “World Forests, Society and Environment” at FAO (Photo 5.27).

(continued)

Box 5.13 (continued)

We discussed the future scope and contents of our volume two publication. El-Lakany with the representative of FAO Susan Braatz participated somewhat our discussions. El-Lakany had nominated her for our mutual cooperation. El-Lakany had also created a new strategy for the Forestry Department and was proud to introduce it to us. Hosny El-Lakany gave an impression of a determined director. He also for first time in history could declare that illegal logging and corruption no more were taboos at the Forestry Department (El-Lakany 2001).

I interviewed in June 2011 Jan Heino, ADG of the Forestry Department of FAO in 2006–2009. I asked him, what was his most important achievement as the Head of the Forestry Department? His response was that it would be objectively found shortly, when the external evaluation of FAO will be completed. His subjective feeling was that his transparent and staff members' appreciative and motivating management gave an example for FAO. Heino stressed also his consolidation of the working of the Collaborative Partnership of Forests with its 14 members and his renewal of the operations of the FAO Committee on Forestry.

I told Heino finally, that perhaps three and a half years is a rather short time for effective management of such a multinational and global organization as FAO Department of Forestry. He said that the period was long enough to mobilize new initiatives but too short for implementing structural changes and renewals. Heino had to retire in 2009, when he reached the standard retirement age 62 years of FAO. Below is the list of heads of the FAO Forestry Department provided by Heino. It has 11 office holders from 10 countries. Only Finland is represented two times.

FAO Forestry Department – a total list of Assistant Director-Generals

Marcel Leloup	France	1946–1959
Egon Glesinger	Austria	1959–1963
N.A. Osara	Finland	1963–1968
B.K. Steenberg	Sweden	1968–1974
Kenneth King	Guyana	1974–1978
M.A. Flores Rodas	Honduras	1978–1988
C.H. Murray	Trinidad and Tobago	1988–1994
David Harcharik	United States	1995–1998
Hosny El-Lakany	Egypt	1998–2005
Jan Heino	Finland	2006–2009
Eduardo Rojas-Briales	Spain	2010–present

Note: Prior to 1972, the Forestry Department was a Division, and the official title of the head of Forestry was Director

5.8 Discussion and Conclusions

5.8.1 Socialistic Forestry Revisited

This chapter was written as a response to Chaps. 3 and 4 introducing Finland's historical forest transition from 1900 to 1960. A description of a contrasting deforestation situation was aimed for. The analyses of both Finland and the tropics were executed within a same theoretical frame of Chap. 2.

Surprisingly few studies have focused the changes of forest resources in different forest ownership categories. NGOs such as Forest Trends and Rights and Resources Initiative have, however, mobilized studies in this front. White and Martin (2002) and Sunderlin et al. (2008) made important assessment of the state and changes in global forest ownership from 2002 to 2008. They also described some cons and pros of each ownership category. Siry et al. (2009) reviewed somewhat older data of forest ownership and made also some comparisons of different categories. Surprising feature in all the three studies is that they did not apply any relevant theories, such as property rights and public choice.

In Sect. 5.1 we defined socialistic forestry, state forestry, and private forestry. Socialistic forestry is practiced in a country where all or most of the forests are in public ownership and where stumpage prices are set centrally under the respective market prices. State forestry is run in a situation where a minority of forests is publicly owned and stumpage prices follow the respective competitive markets. Private forestry is conducted when individuals, communities, or firms own the forests and stumpage prices are determined under competitive markets.

We were not able to falsify the hypothesis with empirical data that public forestry with underpricing and corruption leads to deforestation. We also tried to falsify with empirical data the hypothesis that private forestry and state forestry expand forest resources but we failed. Accordingly, we can maintain our hypotheses that socialistic forestry is contracting forests and private forestry and state forestry are expanding forests.

5.8.2 Deforestation Modeling in Poor and Less Poor Tropical Countries

A great deal of research on the underlying causes of tropical deforestation and forest transition has been executed during the most recent few decades (Sect. 2.2). Active researchers in this field come from more than ten different disciplines. A surprising finding was that a number of them had no understanding of the quality of national forest area or deforestation area data. According to our view these data should be conceptualized as estimates of scientific observations. In each application the quality of forest data should be reviewed.

Only occasionally any assessment of validity and reliability of data had been done (Mahapatra and Kant 2005). Until lately even the annual data of FAO Production Yearbook on forest areas until 1995 have been used by mistake in modeling (Culas 2007; Foster and Rosenzweig 2003; Bhattarai and Hammig 2001; Koop and Tole 2001; Allen and Barnes 1985).

In our own modeling we have used mostly the 1995 data (FAO 1999) for the following four main reasons. First, the explicit reliability assessment was available, which we used in order to give more weight to more reliable data. Second, both the original year (1970–1992) and updated year 1995 data were available. We applied both of them to verify their applicability. Third, also sub-national data, for example state-wise data in Mexico, were available. Later FAO assessments never published these data. Fourth, natural forests and plantation forests were published separately. However, we also used the 2005 data in comparative modeling (FAO 2006).

In Sect. 5.1 we found out theoretically, with empirical data and a review of literature, the key role of corruption in tropical deforestation process. In Sect. 5.2 we arrived at the same finding in our quantitative multiple variable regression modeling. Corruption was statistically significant with almost zero risk both among the 74 tropical countries and in the tier of 37 less poor tropical countries, while it was not significant among the tier of the poor 37 tropical countries. In all three cases the sign of its regression coefficient was an expected plus – the more corruption, the more deforestation. We may assume that among the poor tropical countries the forest resources are also so poor that there remains no motivation for corruption.

Perhaps a unique finding in the tier of the less poor countries was that the regression coefficient of the plantation forest density became statistically significant with almost zero risk (Table 5.2), whereas in the total group (Table 5.4) it was not significant. Foresters commonly argue that the expansion of plantation forests will slow down deforestation of natural forests.

In a group of better off tropical countries this argument seems to be true but not overall, and particularly not among the poorest countries (Table 5.3). Environmentalists, on the other hand, often argue that plantation forests are increasing deforestation. This can be true sub-nationally, when planting is done on sites of cleared natural forests but according to our modeling it does not hold at the national level.

Nearly all of the natural forests in the tropics are in public ownership. Accordingly, forests are remarkably undervalued due to the prevailing administrative underpricing of stumpage. Clearing for agriculture or infrastructure is therefore excessively expanded, when the opportunity cost of sustainable forestry is made artificially too high.

A remedy to this failure is the market valuation of all forest goods and services, which would make the opportunity cost of sustainable forestry operational. Raising the stumpage prices at the levels of the markets would also terminate the primary financing source for corruption. It is interesting that this pricing remedy to the multi-sector deforestation lies within the institutions of forestry itself. This is against a common belief that the underlying causes of deforestation are located outside forestry (e.g., Douglas and Simula 2010).

5.8.3 Causes Underlying Expansion of Plantation Forests

Why have plantation forests been expanding while natural forests have been declining in the tropics? This knowledge is also important to understand the potential operationality of the Kuznets curve in a forest transition. We tried to respond to this issue by modeling the underlying causes of the expansion of the tropical plantation forests (Sect. 5.3).

We specified the multiple variable regression models according to the hypothesis of Fig. 2.4. The ranking of the statistically significant independent variables according to the standardized coefficients was the following: relative natural forest area, GNP/land area, poverty, corruption and openness of trade. This ranking can be interpreted to imply the strength of their causal impact on increasing plantation forest area. They all increased plantation forest area. The two ecological variables were excluded from this ranking. Their role was to harmonize the ecological conditions of the 71 tropical countries in this modeling (three countries did not have the relevant data). Agricultural productivity was also along but did not become statistically significant.

Maybe in this modeling we were missing two relevant independent variables: financial profitability of investments into tropical plantation forests and the ownership pattern. Tropical industrial plantations have been expanding because it has been profitable activity along with acceptable risks. The internal rates of return of the investments in various plantation forests in Vietnam were 11–32% (Lamb 2011).

In Sect. 5.3 similar findings were introduced from Brazil and the Philippines. The tenure conditions have also been different from tropical natural forests with 90% of public ownership. About a half of the plantation forests have in 2005 been in private ownership (Del Lungo et al. 2006). This kind of ownership has improved the ability of the management to close the access to forests and increased the value of plantation forests. Timber, especially from industrial plantation forests, has been sold via markets. Also a stronger motivation to protect plantation forests is increasing along with higher value of forests.

The ecological importance of plantation forests has been increasing along with the global politics of climate change, which is illustrated by the following citation.

> The UN Convention on Climate Change and the Kyoto Protocol (UNFCCC 2008) provides for mechanisms to offset greenhouse gas emissions, including afforestation, reforestation and reduction in deforestation and forest degradation, to mitigate the impacts of climate change. Thus, planted forests, with their relatively high rates of growth and productivity, provide a high rate of annual carbon sequestration and provide a valuable carbon sink. In addition, the increasing wood product flows from planted forests provide long-term carbon storage (p. 16 in Carle and Holmgren 2008).

5.8.4 Causes and Scenarios of Deforestation in Mexico

The United Mexican States (Mexico) was chosen as a case study country for three reasons. First, the 32 individual states provided sufficient observations and data for

our deforestation modeling. Second, community ownership of forests is dominating in Mexico. Third, the country belongs to a group of large-scale forest countries.

The global system causality model of Sect. 2.7 was applied to the specification of our deforestation model both for Mexico and for the 64 tropical countries, where the relevant data were available in 2005. In the former case the forest area data came from the FAO 1999 database and in the latter case from FAO (2006).

According to the estimation of the Mexican model the three ecological variables harmonized the varying ecological conditions among the 30 states. Increasing income (decreasing poverty) and increasing agricultural productivity were decreasing deforestation, whereas increasing GDP/land area and corruption were increasing deforestation. The corruption variable was not available at the level of Mexican states but it was observed to be high in Mexico and assumed to be effective also at the state level. These findings were similar for Mexico and 64 tropical countries.

The model of 64 tropical countries used the forest area data from FRA 2005, while earlier the 74 tropical country model of Sect. 5.2 used the respective data of FRA 1995. The two models gave similar outcomes but the former explained 63% and the latter 74% of the variation of the relative forest area. The latter had an additional statistically significant independent variable openness of foreign trade.

About 80% of the Mexican forests are in community ownership, which theoretically (Sect. 2.5) should support sustainable forestry. However, in Mexico deforestation was continuing in a similar way as under socialistic forestry of the 64 and 74 tropical countries. Papua New Guinea is the only other country in the world with traditional community ownership of forests. We observed that deforestation was continuing also there.

In the United States, Sweden, Finland, Norway, France, Austria, Japan, South Korea, and Costa Rica most of the forests are in private ownership. All of those countries also have forest cover higher than the world average 30% of the land area. No deforestation is taking place in those countries. On the contrary forests are expanding (FAO 2006). These cases illustrate the key role of forest tenure: socialistic forestry and community forestry countries continue deforesting, while private forestry countries have had forest transitions.

5.8.5 Role of Tropical Forests in Alleviation of Poverty

An inverted HDI was adopted as our dependent variable. We specified our multiple variable regression model with the livelihoods theory of the five capital approach: human capital, social capital, financial capital, physical capital, and natural capital. It was concluded that a joint attack by all these five different capitals was needed in effective alleviation of poverty. While poverty had appeared as one of the strongest underlying causes of deforestation, it was relevant to study also the underlying causes of poverty.

In our multiple variable regression modeling natural and plantation forests, openness of trade, agricultural productivity, the degree of urbanization, corruption and

the continental location of the country became statistically significant with expected signs. They jointly explained 91% of the national variation of poverty in the 74 tropical countries in 2004 (Palo and Lehto 2011). Accordingly, we have a clear idea of the underlying factors of the variation of poverty by 74 tropical countries, which cover 96% of the total human population in the tropics.

Natural forests and plantation forests became statistically significant in a two-independent-variable model with expected signs. The two forest variables jointly explained 25% of the national variation of our poverty variable. Then agricultural productivity replaced plantation forest as an independent variable with natural forests. They both were statistically significant with expected signs. Natural forests and agricultural productivity jointly explained 47% of the national variation of the poverty variable. The replacement of plantation forest by agricultural productivity doubled the explanation power of the two-variable model on the national variation of poverty.

5.8.6 Wild West in Uses of Forest Data in Deforestation Studies

We have analyzed in this chapter the underlying causes of deforestation, expansion of plantation forests and poverty using 37, 64, 71, and 74 tropical countries as observation units. We also modeled underlying causes of deforestation in Mexico, where the data was based on 30 individual Mexican states. Reliable time series were not available. Therefore, we have applied panel data in a belief that time dimension is inherently along in these data due to highly different development stages of the sample countries or the Mexican states.

We have used relative forest areas as stock variables in our modeling. Stock variables can be assessed more reliably than change variables or deforestation areas. A forest area estimate can be based on a single forest inventory with one sampling error, while deforestation area estimate requires at least two inventories with a combination of two sampling errors plus likely biases due to different inventory concepts, classifications, and methods between the two inventories. We have applied two to three ecological variables in our modeling to harmonize the varying ecological conditions among countries or states. This has improved our estimates on the coefficients of the socio-economic variables.

The varying quality of forest data, especially deforestation data, in the different FAO tropical forest assessments and other mostly remote sensing deforestation monitoring activities has largely remained unnoticed in deforestation modeling by other authors. When explicit evaluation has been given, it has ironically failed to tell the truth.

The situation is also surprising from the publishing point of view by a number of scientific journals. Why forest scientists familiar to forest inventories are not regularly invited as referees?

It is no wonder that no consensus on the causes of deforestation has been reached by the numerous active scientists in this interdisciplinary field of modeling underlying

causes of forest transition or deforestation in the tropics. The scientists come from more than ten different disciplines mostly with no or only minimal knowledge of forest inventory and mensuration as a scientific discipline. This inference is based on their published papers.

López and Galinato (2005) discussed a little of the quality of deforestation data by FAO. They arrived to a conclusion based on Angelsen and Kaimowitz (1999) that "the FAO data on forest cover is quite unsatisfactory to implement econometric analyses of deforestation" (p. 2 in López and Galinato 2005).

This is a too common statement on FAO data, when above (Sect. 5.6) we have seen that there is quite a variation among the different FAO sources. The authors selected an approach based on outcomes from micro studies. They conveyed modeling of poverty, agricultural expansion, and road building based on an idea that these factors were the most important direct factors of deforestation.

We have not seen a discussion about the relevance, validity, and reliability of the use of solutions as dependent variables in deforestation modeling. A simple fact based on the sampling theory tells us that a stock variable (forest area) is more reliable than a change variable (deforestation area).

For example, Kauppi et al. (2006) never referred to this lowered reliability, while they used a 15-year change in forest data of 50 largest forest countries in their analyses. In fact, their data source was FAO (2006). They never mentioned a word about the quality of their data. They used change data of forest areas, growing stock, and carbon stock. They did not tell that the reliability of data was declining in this direction. Most global forest area is missing statistical sampling-based measurements on changes of growing stocks of trees and carbon stocks.

In a number of deforestation modeling agricultural land area is chosen as a dependent variable (e.g., Barbier and Burgess 2001). No discussion is attached about the validity of such variable in measuring deforested area. Agricultural land in the tropics can be converted not only from forests but also from savannas, open woodlands, and peatlands depending on the local conditions.

The improved quality of the follow-up of deforestation and forest degradation as well as expansion of plantation forest and natural reforestation would provide key information for reducing emissions from changes in forests. After 3.5 billion USD donations for REDD+ at the UN Copenhagen Climate Change Congress in December 2009 (UK Government 2009) funding this activity would perhaps be available.

Approximate costs of maintaining an up-to-date monitoring system is introduced here from Finland in order to get an idea of the magnitude of costs of a modern forest monitoring system. A continuous national monitoring system of forest resources (Box 5.4) is presently managed by about EUR 2 million annual budget. The whole country is covered in 5 years. Accordingly, the total budget for one full round of this multiple-source national forest monitoring is about EUR 10 million. It covers ground sampling, remote sensing, sourcing data from the National Land Survey, processing of data, and publishing the findings. The labor input comprises 18 man-years by technical staff and 13 man-years by researchers or as a sum for one year a total of 31 man-years and for the 5-year round to cover all Finland 155 man-years (Kari Korhonen, Metla, 2 May 2011).

5.8.7 Global Forest Politics Have Been Ineffective

The effectiveness of FAO in order to halt deforestation has been duly criticized (Humphreys 1996). FAO has had perhaps too strong dependency on its national member governments in the annual strategy meetings and a subsequent dependency on consensual decision-making (Saastamoinen 2009). FAO lost its leading role in global forest politics in the early 1980s, when the new global policy instruments against deforestation were initiated and launched by other global actors (IUCN, ITTO, TFAP, WWF).

Since 1945 until the early 1980s FAO acted primarily as a global clearance office for forestry statistics gathering, analyzing, integrating, and publishing but without global political vision, will, and enforcement capacity. However, a number of field projects with varying effectiveness became implemented (Boxes 5.6, 5.7, and 5.8) and a couple of new forestry paradigms, for example, progressive forestry in 1949 and multiple use of forests in 1960, were introduced by FAO.

Since the 1980s FAO has continued its basic mission as a generator of global forest statistics and information. The FAO Yearbook of Forest Products has been published annually. Timber trends studies have produced scenarios for forestry and forest industries. Numerous FAO Forestry Papers have produced useful information. FAO has allocated major resources in global forest resources assessments in 1990, 2000, 2005, and 2010 as described in Sect. 5.6. Otherwise in global forest politics FAO has since the 1980s joint various teams of IGOs and ENGOs in joint attack on deforestation with no success so far.

ITTO has had a most challenging mission and its operations have not been effective. After a quarter of a century of ITTO's actions, tropical deforestation is running rampant (Sect. 5.1). Trade in tropical timber products has been declining. Only plantation forests and pulp mills in a few tropical countries (e.g., Brazil and Indonesia) have been increasing. I have never seen an objective external evaluation of FAO's or ITTO's activities.

As a conclusion an implication of this review is that the World Bank may have succeeded better both in *de jure* and *de facto* in supporting sustainable forestry than FAO or ITTO. The bank has acted also differently from the two other IGOs with its alliance of WWF against deforestation. It may have produced better outcomes in decelerating deforestation than the field projects by FAO and ITTO. On the other hand, the scale of forestry investments has since the 1980s comprised only between 1% and 3% of the total lending of the bank (Douglas and Simula 2010). The World Bank has been leading also in changes of its forestry strategies in 1987, 1991 and 2002 toward more environmental and social sustainability than the other agencies.

Carbon emissions from tropical deforestation have been assessed as about one fifth of all the human-origin global greenhouse gas emissions. Reducing Emissions from Deforestation and Forest Degradation (REDD) was launched in 2008 by the United Nations as an integrated approach to fight against climate change. It is an incentive for developing forested countries to protect, better manage, and wisely use their forest resources. REDD aims to create a financial value for the carbon stored

in the standing stock of trees. The nine participating developing countries are paid against verified reductions of carbon emissions (REDD 2011).

FAO, UNDP, and UNEP have joined forces in managing this initiative in close collaboration with UNFF and a number of climate change and other global bodies. By the end of 2010 Norway, Denmark, and Spain have donated USD 94 million for funding this activity and nine partner developing countries had prepared their country programs. Fifteen new partner countries became registered in REDD during 2010 (REDD 2011).

The UN-REDD has a valid aim to raise the value of the remaining growing stock of tropical forests. We did not find any remarks on administratively set low stumpage prices or corruption in this initiative. A weak spot seems to be the national lack of political will and expertise in forest change monitoring. It cannot be created overnight. This capability is essential to facilitate empirical verification of the reduced emissions.

"The ownership of forests is often unclear or contested. Governance is weak and corruption and power struggles at many levels are strife. Most countries do not have good data, or the skills and systems to measure forest carbon" (p. 1 in Angelsen 2009). These aspects increase country risks in enforcement of the UN-REDD. A lot of funds were earlier wasted in joint TFAP activities in fight against deforestation due to not identifying the roles of the various underlying causes of deforestation, such as underpricing stumpage and corruption.

The methods of advocacy by ENGOs have been developed as learning by doing. Traditionally advocacy has referred to campaigning, which involves attempt to change public opinion, and lobbying, which aims to change structures, policies, and practices that institutionalize poverty, injustice, and deterioration of the environment. Campaigning encourages public support for facilitating environmental improvements.

Bill Clinton, the former US president, ranked in 2006 the influence of the NGOs, along with the extension of democracy and the Internet, as one of the three major global changes since the demise of the Cold War that give the ordinary people the further capacity to effect global change for better direction (Rugendyke 2007).

5.8.8 Conclusions

Chapter 5 is composed of seven different substudies, which, however, have various interactions and support of each other. Section 5.1 analyzed the roles of corruption and underpricing of stumpage on deforestation theoretically, with empirical data and literature review. The statistically significant role of corruption in increasing deforestation became supported later on by the estimation of the 74 tropical country model with seven other independent variables in Sect. 5.2 and by the estimation of the 64 tropical country model with five other independent variables in Sect. 5.4. Corruption variable was also significant in the plantation model of Sect. 5.3.

It was of specific interest to compare the estimation outcomes of the 74 tropical countries of Sect. 5.2 and those of the 64 tropical countries of Sect. 5.4. The forest

data of the former was based on FRA 1995 and of the latter on FRA 2005. The major findings, such as the impacts of poverty, GDP/land area, and corruption supported each other. Unfortunately, the models were not quite identical.

In the tier of less poor tropical countries of Sect. 5.2 plantation forests were decelerating deforestation. They were also alleviating poverty in the two-independent variable model of Sect. 5.5.

Agricultural productivity was decelerating deforestation both in the tier of poor and among all the 74 tropical countries. It was also a significant factor to alleviate poverty in the two-independent variable model.

Sections 5.2 and 5.3 are connected via the Kuznets hypothesis. Our deforestation models of Sect. 5.2 illustrate why deforestation of natural forests is continuing and our plantation model of Sect. 5.3 shows why the U-turn is taking place. Unfortunately, some key variables are missing from the models, such as financial profitability of plantation investments, property rights, and stumpage prices.

Section 5.6 analyzes the quality of forest area data applied in Sects. 5.1, 5.2, 5.3, and 5.4, 5.5. Empirical forest area data have been varying by quality in different FAO sources. We have applied mostly the 1995 forest data but a comparison to the use of the 2005 data was made possible in Sect. 5.4.

Section 5.7 reviewed the global forest politics against deforestation. In fact this section is matching all the previous sections. The failure of the global forest politics to stop deforestation of the natural forests is made better understandable by the analysis of the role of corruption and underpricing of stumpage in Sect. 5.1.

As a conclusion of Sect. 5.1 our theoretical reasoning complemented with the empirical forest area data and a review of literature has indicated the main underlying cause of a continuous large-scale tropical deforestation. It remains as underpricing of stumpage of standing timber, which provides funding for continuous severe corruption, which is maintaining this pricing system. Corruption again leads to illegal logging, forest degradation and deforestation. A simple remedy would be to transform the stumpage pricing to match the relevant markets and to remove this way the primary financing source of corruption.

As a conclusion of Sect. 5.2 we may review the findings of the 74 tropical countries. According to our modeling increasing poverty, GNP/land area, openness of external trade and corruption all increased deforestation. Only increasing agricultural productivity decreased deforestation. The risk that the regression coefficient of openness of external trade did not deviate from zero was 1.3%. The other variables received almost zero risks in our modeling. The partition of this group of 74 countries according to the size of HDI into two tiers of equal sizes revealed fresh insights to the tropical countries. In the tier of 37 less poor countries plantation forests seemed to decelerate deforestation but not among the poor countries.

As a conclusion of Sect. 5.3 in our modeling of the expansion of the plantation forests in 71 tropical countries (3 countries did not have relevant data available) we found that increasing natural forests, poverty, GNP/land area and corruption expanded plantation forests. The risk of corruption variable was 1.6% and almost zero for the other independent variables. Increasing openness of trade expanded plantation forests with a risk of 11.2%. The model explained 77% of the variation of relative

plantation forest area in the 71 tropical countries. To our knowledge this is a pioneering modeling of causes of the expansion of plantation forests in the tropics.

A final conclusion of Sect. 5.4 is that modeling of deforestation in Mexico with community forests prevailing and the 64 tropical countries with the public forests prevailing (FAO 2006) produced similar findings of continuous deforestation. The community forest ownership should theoretically (Sect. 2.5) carry out more sustainable forestry than the public forest ownership. Here deforestation continued in both cases.

As a conclusion of Sect. 5.5, how to promote the opportunity for the poor? The statistically significant findings of our modeling suggest that corruption should be reduced to a workable level, deforestation of natural forests should be decreased, plantation forests expanded and especially agricultural productivity increased by raising human capital and relevant infrastructure as well as urbanization in the form of structural differentiation and openness of trade promoted.

A conclusion of Sect. 5.6 can be made that the uses of empirical national forest data in deforestation studies have resembled the illegal behavior of cowboys in the historical frontier of the Wild West in the United States. Only rarely any true evaluation of the quality of the data has been done. Most likely very few of the authors have realized that the data of national forest area, deforestation area or growing stock of trees should be understood as sampling estimates of the true population values including sampling errors, errors due to definitions and classifications as well as potential biases. A monitoring system from Finland was described as an illustration of the scientific nature of national forest inventories.

As a conclusion of Sect. 5.7 how can the prevailing socialistic forestry (Sect. 5.1), with wide corruption and deforestation, be transformed in any available planning horizon into a transparent, effective, cost efficient, and fair sustainably managed forestry? For us this is a distant utopia! Law and order with major and profound tenure reforms are the cardinal preconditions. The relevant institutional reforms require also strong political support and a very long time.

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